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RESTORATION OF GASTRO-INTESTINAL CONTINUITY BY MEANS OF ANTICOLIC GASTROJEJUNOSTOMY FOLLOWING PARTIAL GASTRECTOMY FOR CANCER OF THE PYLORIC END OF THE STOMACH[1]

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THE cure of cancer of the stomach by surgical removal is being accomplished with an increasing frequency, a fact largely due to the progress which has been made in the two most important phases of the subject, viz., diagnosis and treatment.

Prominent factors which have contributed toward more accurate and earlier diagnosis have been: the better appreciation of the clinical history, the X-ray, and the relative values of each; the recognition of the necessity of most thorough investigation of early symptoms, and particularly, of the danger of neglecting the chronic gastric ulcer; and a decreasing pessimism on the part of both the laity and the medical profession in their attitude toward cancer of the stomach.

The surgical treatment of cancer of the stomach has become more efficient, not only because of the foregoing, but because of the following facts: There is a general improvement in surgical technique, a more exact knowledge of the surgical limitations in gastric cancer, and the development of the technical methods employed in gastric resection.

The methods of gastric resection which have been most successful in our clinic during the past decade are:

1. The Billroth No. II operation which gave decidedly better results than any of the preceding methods. It was employed for some years with much satisfaction. This operation of resection and suture posterior gastro-enterostomy, was necessarily varied by circumstances, so that anterior gastro-enterostomy and a Murphy-button anastomosis occasionally were indicated and made use of to re-establish the continuity of the gastro-intestinal tract.

2. About four years ago the so-called Polya operation which seemed to possess quite obvious advantages over the Billroth No. II in a considerable percentage of cases was adopted in the clinic. This operation, described by Dr. W. J. Mayo in 1915, while followed by better results than the Billroth No. II, still presented technical difficulties under certain conditions, particularly following extensive gastric resections. In such cases it was sometimes quite impossible to bring the gastric stump with the attached jejunum satisfactorily through and below the level of the opening which had been made in the transverse mesocolon.

3. During the past few months we have used the following method — a method which has given better results than any we have heretofore used, and inasmuch as it has other advantages, we now consider it the best routine operation for the removal of gastric cancer.

[1] Submitted for publication September 11, 1917.

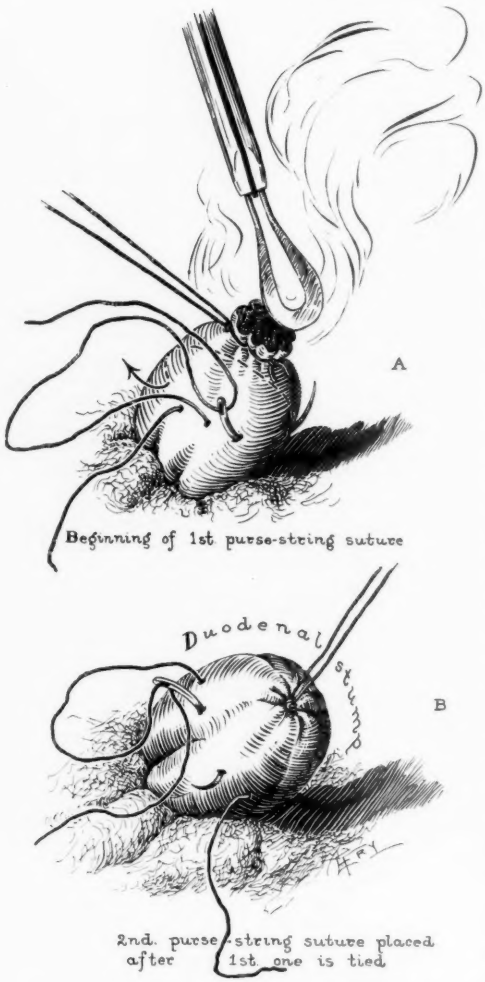

Fig. 1. *A*. The end of the duodenum transfixed and tied with catgut. The actual cautery used for sterilizing stump beyond ligature. The purse-string suture in place. *B*. The stump inverted and first catgut purse-string suture tied. Second catgut purse-string suture in place below the first. A few interrupted silk sutures may be placed to draw together the sheath of the pancreas and omenta in the vicinity, thereby burying the end of the duodenum.

The resection is carried out in the ordinary way with especial attention to such important points as the wide removal of gland-bearing tissue, the avoiding of injury to the middle colic blood supply of the transverse colon, the resection made well beyond the cancer limits, the cauterization of all cut mucous surfaces to prevent cancer-cell transplantation, and the secure inversion and burial of the duodenal stump. The operative field is inspected and carefully isolated by fresh packs and the second stage is carried out as follows (Figs. 1 and 2):

The first loop of jejunum is procured and a point about 14 to 18 inches from the duodeno-jejunal angle is marked. The jejunum is then carried up in front of the transverse colon and omentum and a segment of suitable size is chosen at the point already marked. This section of jejunum is lightly grasped with rubber-covered forceps, and directed so that the proximal end of the loop will be approximated to the lesser curvature of the stomach. A series of interrupted silk sutures in the serosa is used for the first line posteriorly, beginning at the greater curvature. All these sutures are placed before any are tied, and the ends of the top and bottom sutures may be conveniently left as guides. The first suture line is about one-half inch below the clamp on the cut-end of the stomach, and on the side of the jejunum about three-fourths of an inch from the summit of the loop. In extensive resections it is extremely important to get the best possible exposure of the lesser curvature, for at this point it is occasionally difficult to make a secure anastomosis, and it is along the lesser curvature that inflammatory products frequently extend, rendering the gastric wall friable and a distinct source of danger. Any measure in such cases which will prevent retraction of the lesser curvature should be utilized. We still find the right-angled rubber-covered clamp of greatest service for this purpose. The jejunum is now incised on the line (Fig. 3, frontispiece) and the crushing clamp removed from the stomach. (If it has been possible at any previous stage in the operation to place without difficulty a straight rubber-covered clamp at a higher level on the stomach, soiling by unevacuated gastric contents will be prevented.) Any actively bleeding vessels are ligated. The posterior row of the anastomosis uniting the posterior wall of the stomach to the inner cut edge of the jejunum is of chromic catgut. The stitches on the

Fig. 2. End of duodenum closed, vessels ligated and fat and glands isolated with the carcinomatous portion of the stomach. Section being made with an electric cautery knife.

gastric side should be taken after the edge which has been crushed by the clamp has been trimmed with the scissors. A second row of finer catgut may be used to advantage in the posterior line. The first chromic catgut suture is continued in front in the usual way to complete the closure. An interrupted silk suture line similar to that used posteriorly is placed anteriorly, particular care being taken to reinforce the angle of anastomosis at the lesser curvature. A few interrupted silk sutures are placed where necessary further to protect the anterior suture line and the suture at the lesser curvature, the stump of gastrohepatic omentum which contains the ligated gastric artery being utilized as a support to the gastrojejunal angle at this point.

The procedure as described is applicable to the majority of cases (Fig. 4). When, however, chronic pyloric obstruction has greatly dilated the stomach, the gastric outlet after resection is often much larger than is necessary for the anastomosis. Under such circumstances, the outlet may be decreased by partly closing it at the upper angle with sutures, as advised and practiced by Dr. C. H.

Mayo, or the outlet may be approximated to a much smaller opening in the jejunum by suitable suturing. Thus, if the gastric outlet is one-third larger than the size of the opening desired in the jejunum, the intervals between all stitches on the gastric side should be one-third greater than those on the jejunal side. The readiness with which the stomach will adjust itself is, of course, largely dependent on the fact that its great size is abnormal and the stretched-out tissues tend to contract rapidly. However, it has been our experience that there is no objection to an anastomosis of considerable size (Fig. 5).

The advantages of the anticolic end (gastric) to side (jejunum) method are quite obvious. It has been our experience that it can be used in practically every case, that it is simpler, safer, and can be accomplished in less time than any other method. The operation may be completed well within the hour and if conditions for operation are favorable even within half an hour. Its particular advantage is seen, as I have intimated, in extensive resections, when such a small segment of stomach remains that posterior gastro-enterostomy would be difficult. This fact makes it quite possible that not only will the method result in more radical operations in gastric cancer but by reason of this advantage it will occasionally permit resection in cases heretofore considered inoperable. No disadvantages in the method have been encountered and it has been the experience of the surgical staff at the clinic that patients in whom this method has been employed are less subject to postoperative complications than are those who have been operated upon by other methods.

Fig. 5. Position of the anastomosis with relation to the transverse colon on replacement of the viscera after completing operation. Abdominal wound ready for closure.

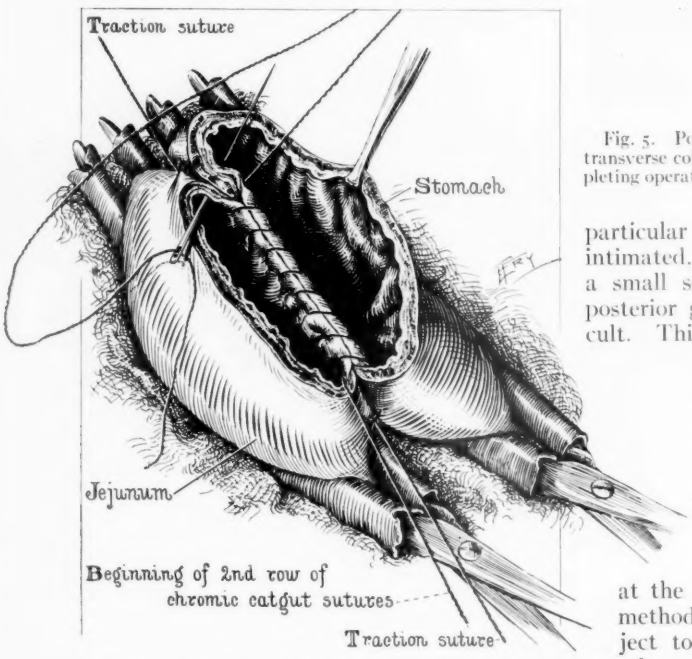

Fig. 4. Completion of gastrojejunal union by continuous through-and-through suture of chromic catgut

That the operation is of less risk than other methods is very definitely shown by our operative mortality statistics. From January, 1907, to August 16, 1917, in 318 resections by the Billroth No. II method, there was an operative mortality of 13.2 per cent; in 104 cases by the Polya method, a mortality of 14.4 per cent, while in 38 cases with the method I have described the mortality was only 5.2 per cent. This comparison of operative mortality is quite fair inasmuch as the operations were done by the same surgeons in the same clinic with similar surgical indications.[1]

[1] The statistics of the operative mortality following the Billroth method No. 1, the Kocher method, and segmental resections in the clinic are not quoted as they are not comparable.

SECTION OF THE DUODENUM

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We believe that a report of this extraordinary case of complete section of the duodenum, which we have studied in the Rawson Hospital, will be interesting and valuable. We know of reference to only one similar case which was cited by H. Meunier and which was seen at an autopsy and referred to by Moynihan in his book on duodenal ulcer, page 281. A report of the case follows:

J. M., a workman, age 60, had lived in Argentine for 40 years. His critical illness dated back only a year, but he has had gastric symptoms for a longer period. He cannot describe his condition well for he is not an educated man. During his illness, he has had periods of complete relief, lasting one to three months at a time. His most important symptom is pain which comes immediately after meals. The pain is situated in the epigastrium and radiates to the left costal margin and to the dorsolumbar region; sometimes he feels the pain between meals and at night, but more often at the end of his meals. The pain moderates on pressure, when he is lying down and when he is eating. The pain is accompanied with pyrosis and often provokes vomiting, which brings immediate relief. The intensity of pain varies with the kind and quantity of food which he eats.

For a few months the patient has been very constipated. He has never suffered from melæna or hæmatemesis. His appetite is good although he has lost 28 pounds in the last three months. Physical examination on entrance revealed the following: he was very thin; almost without teeth; the tongue was furred, red and damp at the tip. The abdomen was scaphoid, the liver was small, the spleen not palpable. There was pain in the cœlic point, but no other points were painful. There was no gastric clapotage but succussion was positive. The cæcum was dilated but not painful. There was no pulmonary effusion. Pulse 76 with 80 millimeters pulse tension. The arteries were hard. The senile arc was very pronounced. With the stomach tube, we obtained 50 centimeters of gastric contents which on examination showed: hydrochloric acid, 1.9 per cent, and a total acid of 2.8 per cent. No mucus, lactic acid, or blood was present. With the Ewald test meal we found hydrochloric acid, 1.35 per cent, and total acid 1.95 per cent. No mucus or blood but plenty of pepsin was present. Digestion of carbohydrates and albuminoids was good. The urine was normal. Blood examination showed: reds, 3,030,000; whites, 8,500; hæmoglobin, 65 per cent. Differential count of leucocytes showed: polynuclear neutrophiles, 50.5 per cent; eosinophiles, 0.5 per cent; mononuclears, 9.5 per cent; lymphocytes, 30 per cent; transition form, 0.5 per cent. The Wassermann reaction was positive. The fæces contained occult blood.

The radioscopic examination made the diagnosis clear. A Rieder test meal administered six hours before, demonstrated a pylorus perfectly permeable. The bismuth was found in the cæcum and ascending colon. We made another examination, giving 100 grams of the Rieder food in the recumbent position (Fig. 2). We noted a shadow with a half moon shape which extended to the right costal margin. After all the food had been given, the stomach was noted to be distended and situated low, rather on the right (Fig. 3). It moved well on respiration and by palpation. We saw extensive contractions that commenced in the fundus of the stomach, ended at the pylorus, and followed each other regularly. There were no painful points.

The patient was seen again, twenty minutes later

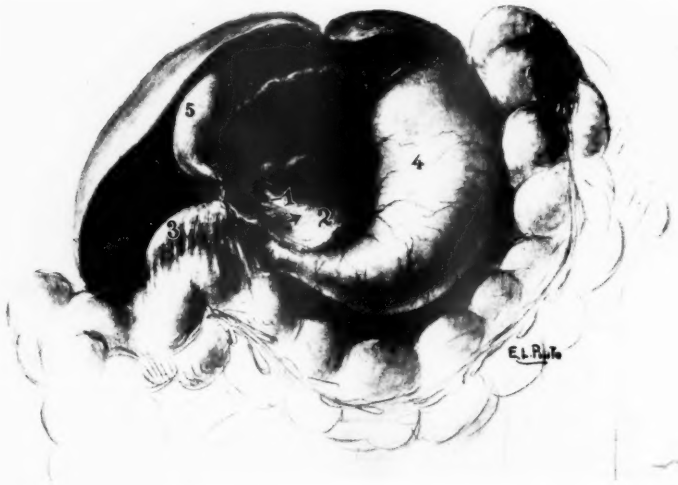

Fig. 1. *1*, Duodenal section; *2*, artificial cavity; *3*, duodenum; *4*, stomach; *5*, gall-bladder. The arrow indicates the pyloric opening.

in the dorsal position, and we observed a shadow very commonly seen in duodenal stricture (Fig. 4). A large black shadow (*A*) against the left diaphragm, another one (*B*) with a semicircular form, which extended from the left parasternal line to the right mammillary which reached the costal margin. Its inferior part is well limited; the upper, on the contrary, shaded off with no clear limit. These two shadows did not change in either decubitus, left or right. We noted muscular contractions in the inferior shadow (*B*) that stop half way without showing clearly the pylorus. The bismuth was seen progressing with difficulty (arrows) in the other part of the duodenum. The patient was made to walk and was observed lying down forty minutes afterward. This examination cleared the diagnosis (Fig. 5). At first the shadow observed was the same as the one in Fig. 4, but with intensive massage, we provoked a contraction of the stomach which made the shadows separate as can be seen in Fig. 5. The figure shows the stomach (*E*) ending with a point. The duodenal shadow well separated and touching the costal margin is shown at (*D*). This was not painful or movable on palpation. When we displaced the shadow (*D*), we moved also the superior part of the ascending colon (*C*) which we presume adhered to the duodenum. With respiration, the duodenal shadow moved well, on the contrary, the colon did not.

An hour and fifty minutes afterward, the patient was again seen in prone position (Fig. 6). There were remnants of bismuth in the stomach, with a prolongation (*A*) in the upper part. It takes the shape of a half moon, though the prolongation (*A*) has not such intense shadow. The part (*D*) corresponds to the duodenum. It had an irregular form, was not painful, or contracted and moved at the same time as the colon. After a second, the patient was once more seen lying down, two hours after the ingestion of the Rieder soup. We observe unformed rests in the stomach (*E*) and the contents in nearly all the duodenum. The first part is dilated, reaching the costal margin, the other one has a small quantity of bismuth, gives a moderate shadow, and was seen to progress very slowly.

The patient's history was suggestive of ulcer of the stomach on account of the pain immediately after eating, the radiation of the pain to the shoulder and its cessation upon compression of the epigastrium in the dorsal position, and by the ingestion of food. In addition to this there was gastric retention as shown by the stomach tube, the hydrochloric hypersecretion when fasting, the presence of blood in the gastric contents, and by the presence also of fermented acids. Notwithstanding the presence of these symptoms, we did not think it stomach ulcer. We based our conclusion on the following: The washing out of the stomach for five days made the gastric retention disappear completely. The radioscopic examination showed a rapid evacuation. It is also well known that duodenal and stomach lesions present very similar symptoms. But to radioscopy belongs the credit of making the diagnosis. We assured ourselves not only of the normal function of the stomach and the absence of any organic lesion but also of gastric hypercinesia very frequent in duodenal lesions. We were able to demonstrate that bismuth remained in the first portion of the duo-

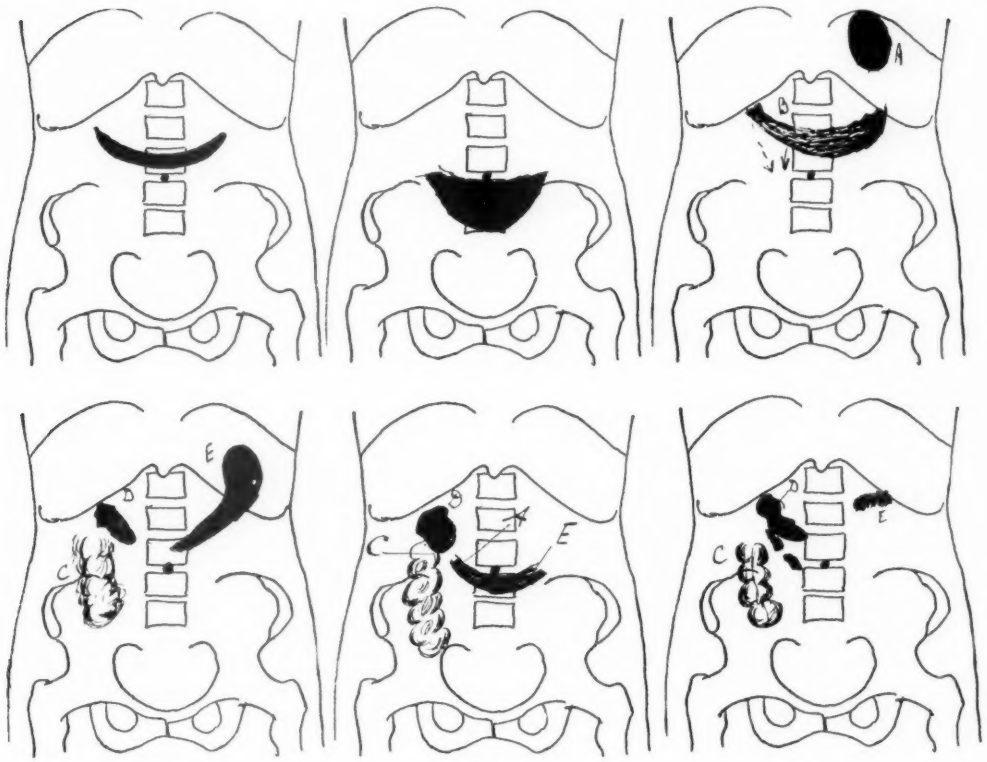

Fig. 2. Fig. 3. Fig. 4.
Fig. 5. Fig. 6. Fig. 7.

Fig. 2. Five minutes after a portion of the second Rieder meal. Patient examined lying down.

Fig. 3. Ten minutes after giving all the meal. Patient standing up.

Fig. 4. Twenty minutes afterward.

Fig. 5. Forty minutes. A massage of the abdominal wall has provoked an intense contraction of the stomach.

Fig. 6. One hour and fifty minutes. Patient in prone position.

Fig. 7. Two hours, stomach nearly emptied.

denum for two hours in several examinations. That only could be interpreted as a mechanical obstacle situated in the hepatic angle of the duodenum. We then made the diagnosis of stricture of the duodenum. The radioscopic examination showed us that the first portion had a size double to what is usually observed, in a dilatation of the first part of the duodenum. The adhesions of this organ to the hepatic flexure of the colon could only be interpreted as being due to an inflammatory process. We then added to stricture of the duodenum the diagnosis of periduodenitis. We finally decided on a diagnosis of stricture of the duodenum at the hepatic angle, dilatation of the first portion and periduodenitis.

As to the etiology, since we investigated for and found the presence of a syphilis not acknowledged by the patient, we treated him first by intravenous injections of mercury. He made such an apparently rapid recovery that he refused to submit to any other treatment and left the hospital a month and a half after his admission.

He remained in good health three months, with no dietetic or medicinal treatment, after which his appetite failed and he felt epigastric pain one hour after his meals. This pain usually lasted twenty minutes. Then he commenced vomiting, which relieved him immediately. The pain was not constant at first, but in the last week it was of almost daily occurrence. He was not constipated. He returned to the hospital in a very bad state generally and much thinner. Palpation of the epigastrium caused him great pain. The gastric retention showed 3.9 per cent of hydrochloric acid and 5 per cent of total acid. With the Ewald test meal: hydrochloric acid, 1.4 per cent; total acid, 2.5 per cent. Dr. José Saralegui, in charge of the X-ray

department in the Rawson Hospital, reported the condition as it was observed months before. Both the chemical and radioscopic examinations called for an immediate surgical operation, for the diagnosis was well established and the patient was doing badly. We also had in this unfortunate man a filiform stricture of the urethra to deal with, so we delayed the operation for a few days, treating the stricture by gradual dilatation.

It is very difficult to determine what caused the reduced state to which the patient had arrived. Was it due to the ulcer or to the phenomena of auto-intoxication from retention of urine?

The operation was performed by Dr. David Prando on April 6, 1916. The laparotomy disclosed the extensive formation of connective tissue over the stomach; the mesocolon and colon spread in the shape of big retracted stars; the walls of the stomach were very thick and œdematous. In the proximity of the pylorus, the walls of the stomach were still more infiltrated. The lesser curvature was firmly adherent to the concave surface of the liver and to the gall-bladder. These adhesions extended also to the pylorus and the first portion of the duodenum. We thought there might be chronic perforation and decided that it was prudent not to attempt to separate the organs. A posterior gastro-enterostomy was performed. The post-operative care was as usual and nourishment was commenced in 24 hours. Following the operation the patient had no other symptoms than those that were attributable to the urethral stricture. On the fourth day, we performed an internal urethrotomy. The urine became normal again. The general state of the patient remained very poor. He died eleven days after the operation.

The postmortem showed the attachment of the stomach to the liver and gall-bladder. We found the gastro-enterostomy in good situation and with a patent mouth. Then we tried to separate the liver from the stomach, finding a cavity artificially created that was the size of a small tamarind and surrounded by a smooth, thick wall covering the neighboring organs. It was at first sight difficult to know how the cavity had been formed and which were the organs that surrounded it. By means of both a gastrotomy and a duodenotomy (second portion) and introducing a sound in each we observed that there was a true decapitation of the duodenum. The hole in the duodenum corresponding to the pyloric region was situated about 1½ inches from the pylorus. We made at that time a drawing as shown in Figure 1.

The hole in the duodenum was deeply situated in the cavity, in relation to the Spigelian lobe. The section was complete with seromuscular borders smooth; the mucous membrane, on the other hand, herniated and was plaited, thus making the cavity appear smaller than it really was. There was between the stomach and duodenum a distance of 3 centimeters. The cavity was limited above by: the concave surface of the liver, to the left side, the small curvature of the stomach; to the right, the gall-bladder wrapped with adhesions; below, the stomach, gall-bladder and mesocolon. The floor was formed by the thick parietal peritoneum. The cavity was empty, whereas in the case of Meunier described by Moynihan, there were remnants of food.

This case leads to a number of conclusions. The first is the advantage of making the diagnosis of ulcer of the duodenum at an early stage, treating thus the ulcer and not the complications. There is no doubt that the remissions produced by the medical treatment are very deceptive, and that it is much better to resort to the more radical surgical treatment. Our patient made such a rapid recovery with the mercurial treatment that no other seemed necessary as he was apparently doing well for four months. If we had not used mercury, the patient would surely have consented to an operation. Another interesting feature of this case was the evolution of the process that made a complete section of the duodenum without giving peritoneal reaction. It was therefore difficult to discover the pathogenesis in this case. Moynihan, among other authors, when he speaks of chronic perforations, describes not only the formation of periduodenal abscesses situated in the neighboring organs, but also those very far from the duodenum. These abscesses, as in the case described by Meunier, involving first the intestine, may invade the wall of the gut and destroy it.

We did not find an abscess; we found an empty cavity to which opened the two extremities of the first duodenal portion. As this cavity was bounded by a thick cover, we believe that the functional work of the gastro-duodenal tract was not much disturbed. There is no doubt that the great acidity of the gastric juice that was retained more than two hours in this cavity caused inflammation, as the walls were not protected by the normal gastric mucosa. It is interesting to note the influence that this artificial cavity had on the gastric function. The stomach showed an insufficient pylorus almost permanent, as the bismuth was completely evacuated in two hours by very energetic contractions. We interpret the gastric retention

that the patient showed at the time of our examinations as a reflex into the stomach from the artificial cavity. In one examination we found blood in the stomach although there was no ulcer.

We must also emphasize the great advantage in making radioscopic examinations in series. In our case we did not arrive at an exact diagnosis when we assumed there was a dilatation of the first portion of the duodenum and a periduodenitis, but, looking over our figures once more and taking into consideration the autopsy findings and noting the exact relation between them, we do not doubt being able, should a similar case occur, to make an exact diagnosis.

Has syphilis anything to do with the etiology of these ulcers? One of us (Escudero) and Dr. G. M. Escalier in the meetings of the Medical Society (Buenos Aires, 1915), spoke in favor of the syphilitic origin of some of these ulcers. We regret not having in this case the microscopical proof, but it was not possible to obtain it.

Some points in this case seem worthy of mention:

1. The slow course of the process.

2. The efficacious action of the medical treatment, which restored the patient to health for four months.

3. The presence of adhesions with retractile shape, irregularly distributed in the colon and mesocolon so far situated from the ulcer as to be not originated by it, proves the existence of a process of long standing.

From what we have just said, we do not affirm the syphilitic etiology of this ulcer, but we would mention it as a cause that is hardly ever considered in connection with a duodenal ulcer.

SOME CAUSES OF OCCASIONAL FAILURE IN THE OPERATIVE TREATMENT OF CHRONIC GASTRIC AND DUODENAL ULCERS[1]

By GEORGE WOOLSEY, M.D., F.A.C.S., New York

SURGEONS do not claim that operative treatment is invariably a sure cure for chronic ulcer of the stomach and duodenum. They claim only that a large percentage of ulcers is so cured, while medical treatment is followed by recurrence in the great majority of cases. Cure, after surgical treatment, varies in different classes of ulcers. The percentage of cures is somewhat higher in duodenal than in gastric ulcers and in those with pyloric stenosis than in those without. Hence the introduction of various forms of pyloric exclusion to simulate pyloric stenosis.

Apart from a very considerable number of gastric ulcers treated by resection, mesogastric resection, and excision, the majority of the ulcers we are considering is treated by gastrojejunostomy, with or without pyloric exclusion. Moreover, in all such cases, except in mesogastric resection, a gastrojejunostomy is or should be added, so that, with this exception and the few treated by gastroduodenostomy, gastrojejunostomy is employed in all cases.

Although a very large percentage of the cases in which gastrojejunostomy is employed is followed by excellent results, reports multiply to show that further experience demonstrates that some of these relapse after a year or two, or even later. What is the cause of this? Of course, operative treatment does not insure a patient from acquiring a new ulcer, but does the operative technique naturally lead to a new ulcer in some cases?

Peptic jejunal ulcers, at or near the stoma, have now been reported in a considerable number of cases. Von Eiselsberg (1) reported an unusually large number of them in his paper read in London in 1914, a surprisingly large proportion of them occurring in cases in which his method of pyloric exclusion had been practiced.

[1] Read before the Surgical Section, New York Academy of Medicine, February 2, 1917.

In October, 1913, I operated on a nurse, M. T., who had given symptoms for 10 years and had had the appendix removed 5 years before. A posterior gastrojejunostomy was done for a moderately indurated duodenal ulcer, using a continuous chromic catgut suture for the inner row and a continuous suture of silk or linen for the outer. The gastric symptoms were relieved for 21 months and then recurred. Medical treatment was tried but the patient grew steadily worse. Two X-ray series did not clear the diagnosis. A second operation was done exactly two years after the first. The duodenal ulcer had healed. From the outside the gastrojejunostomy looked absolutely normal, with no induration and no adhesions. The stomach was opened disclosing the stoma, from the inner margin of which hung three or more inches of the suture and still more was pulled out from the wall of the stoma. There was no ulcer where the suture was hanging from the inner margin of the stoma. I searched for an ulcer in the neighborhood, in the stomach and jejunum, but found none. The operation was followed by complete relief of symptoms, which has continued to date, more than a year.

It is very interesting to note that in spite of ulcer symptoms there was no ulcer, and that the symptoms were relieved by the removal of the suture. It appears, therefore, that symptoms of recurrence of ulcer do not necessarily imply a peptic ulcer of the stoma or its neighborhood, but may depend upon the irritation due to the traction on the suture end hanging from the inner surface of the stoma. It is impossible to say definitely in how many cases this holds, also whether an ulcer would have formed at the site of the suture before it was cast off. Probably in time in all cases the suture would be pulled out and cast off. Based on a few cases in which I have observed gastric symptoms occurring during the first year or so after operation, which have in time disappeared, my own opinion is that the working through of the non-absorbable suture may be accompanied by such gastric symptoms, without ulcer formation, and that relief follows the passage of the suture.

In any event, whether causing ulcer or not, it is my opinion that the non-absorbable suture, which has a tendency to work its way through into the stomach, is responsible for a majority of the cases of recurrence of symptoms after gastrojejunostomy for ulcer.

Since the date of the second operation on the above case I have used no more non-absorbable suture and have found in a considerable number of cases that No. 0 chromic catgut answers perfectly for both rows of sutures. I would strongly urge this practice in all gastrojejunostomies.

I have met with a single case of complete closure of the gastro-enterostomy opening, with a fresh prepyloric ulcer. But as this unusual case of operative failure probably depended on a gastrojejunal ulcer (1) due to the use of non-absorbable suture, it can be prevented by the use of chromic catgut for all sutures.

Five years ago, after a V-shaped excision of a gastric ulcer on the lesser curvature, I was compelled to re-operate because the symptoms were relieved for only nine weeks. I did a gastrojejunostomy, with considerable relief, but the patient was not entirely cured until two years later, when a von Eiselsberg exclusion was done, proximal to the site of excision. At this operation the continued trouble appeared to be due to adhesions at the site of the excision of the ulcer, and to a partial pyloric stenosis. I believe that traction on adhesions at the site of an ulcer accounts for some cases of recurrence of symptoms and that von Eiselsberg's exclusion is the most effective treatment.

I have found by experience, confirmed by that of Mayo (3), Payr (4), and others, that excision without gastrojejunostomy does not cure the patient. I think that some of the poor results and recurrence of symptoms after operation for gastric ulcer are due to the use of excision without gastrojejunostomy.

My experience has made me dissatisfied with V-shaped excision, and in this Payr's (5) opinion bears me out, so that I have determined to discard it in favor of resection or mesogastric resection. There remain, however, a few cases where excision with gastrojejunostomy is indicated as the most available procedure. Thus in two recent cases of indurated ulcer on the lesser curvature, near the cardiac end, I was compelled to employ it, as mesogastric resection would have been exceedingly difficult. I still believe that its very limited use will conduce to better permanent results in the operative

treatment of gastric ulcers and that gastrojejunostomy should always be added.

In a small percentage of cases of duodenal ulcer treated by gastrojejunostomy, recurrence follows or the ulcer fails to heal. This occurs somewhat more often if there is no pyloric obstruction or if the latter exists to the first or second degree only. The stoma fails to drain sufficiently owing to the lack of pylorospasm or stenosis and, if the gastric contents are not neutralized, the passage of the acid chyme over the ulcer does not allow it to heal.

Hence, to avoid occasional failure where there is no marked obstruction, I believe that pyloric exclusion is theoretically indicated and should be tried until there is obtained a large series of cases that can be followed and studied to judge of the results of the procedure. Some method which will hold long enough to allow the ulcer to heal should be chosen. Personally, I generally employ Wilms' method, using a strip of fascia from the anterior sheath of the rectus muscle. It is not necessary for the occlusion to be permanent. The results are good but whether better than without occlusion it is too early to say.

The results of pylorectomy, resection, and mesogastric resection are excellent and the mortality low. There is but little shock as there is so little loss of blood. In such cases, the gastrojejunostomy is, of course, liable to the trouble already mentioned unless absorbable sutures are used.

Surgeons are not agreed as to the use of gastrojejunostomy in the treatment of perforated ulcers when the condition of the patient justifies it. Excellent results without gastrojejunostomy have been reported by Gibson (6), Shea (7), and others; while Paterson (8), Deaver, and others are very emphatic in urging its employment. Personally I favor it whenever conditions warrant it. It is only by the study of a large series of cases, followed for two or more years, that anything like a definite conclusion can be reached.

In the past year a case operated on at Hudson Street Hospital 17 months previously, was operated on by me for recurrence of symptoms for five months, due to a persistent pyloric ulcer. A number of such cases is reported in the literature. Eliot (9) in 1912 collected 57 cases in which persistence of symptoms indicated subsequent gastroenterostomy and was relieved by it, except in a few cases in which it was refused.

A certain, though perhaps a small, proportion of cases of perforated ulcer, operated upon without gastrojejunostomy, will give unsatisfactory late results on account of recurrence or stenosis.

Another reason for failure to cure by gastrojejunostomy is that it is done in improperly selected cases. Eight and ten years ago I operated on two cases who were neurasthenic and very neurotic. Judging by the symptoms there should have been an ulcer, but none was found.

Gastrojejunostomy was done and the results were failures. I believe that in not a few cases a poor result follows gastrojejunostomy because there were no ulcers present and the treatment did not fit the disease. We should be particularly careful to demonstrate an actual ulcer in neurasthenic and neurotic cases before doing gastrojejunostomy. We must also bear in mind that gastric symptoms, suggesting ulcer, may often be due to an extragastric condition, such as lesions of the appendix, gall-bladder, pancreas, etc.

Unless we can see or feel an ulcer, the use of gastrojejunostomy is unwise, leads to disappointment, and discredits the surgical treatment of ulcer. At times it may be very difficult to feel a duodenal ulcer. This is especially true if there is very slight induration, as is often the case with ulcers of the anterior wall. If the lymph-nodes of the gastrohepatic omentum, along the common duct and the hepatic artery, are enlarged, we should look for trouble in the duodenum, gall-bladder or pancreas. If the latter feels normal and the gall-bladder does not look or feel pathological we should be suspicious of any slight irregularity in consistency of the duodenal wall and investigate it carefully. In such cases of suspected ulcer on the anterior duodenal wall, I have found the red stippling test of frequent service.

In cases in which there is an actual ulcer of the stomach or duodenum, there may also be an extragastric condition, especially in the gall-bladder or appendix, which, if not discovered and appropriately dealt with, will continue to give stomach symptoms. If this is overlooked the natural inference is that the operation failed to cure the ulcer or to prevent a recurrence. In all cases therefore the appendix and gall-bladder should be thoroughly explored and, if found abnormal, treated accordingly. Moynihan advises the routine removal of the appendix on the additional ground that there may be a causative relation with the ulcer.

Another cause of late unsatisfactory results is the neglect to remove the sources of origin of fresh ulcers. It is recognized that infection plays an important part in the etiology of ulcer. Hence the teeth and tonsils, especially, should be carefully examined to detect and cure any sources of infection. How rarely this is done, especially in hospital cases! The same source of infection that was responsible for the original ulcer may, after the latter is healed, produce a new ulcer.

Then too the diet should be regulated until the ulcer has had time to heal. We should not rely on operation alone to cure the ulcer but add careful dietetic and, if needed, antacid treatment. In all cases I use a Lenhartz or a modified von Leube diet post-operatively for the first two weeks. After that the diet should be made more liberal, but care should always be exercised and excesses strictly avoided.

How the injunction to be careful of the diet is observed by some is illustrated by the following case, the only one that has returned to me for a second operation for a fresh ulcer:

W. H., a cook, operated on by me in December, 1912, by posterior gastrojejunostomy was well and free of symptoms for nearly two years when, after drinking heavily for three weeks, he entered the medical service of Bellevue Hospital complaining of nausea, attacks of epigastric colic and a chronic cough, with infiltration at the apex of the right lung. The gastric analysis was then normal. He was again well until four months before his readmission March 29, 1916, when he gave as his daily habits, coffee ten to twelve cups, cigarettes twenty to forty, alcohol, two to three pints of beer and occasional whisky. He was operated on a second time April 28, 1916, when an indurated prepyloric ulcer, situated antero-inferiorly and encroaching on the duodenum distally, was resected. The former ulcer, situated posteriorly, had healed.

Whether his habits were responsible for the recurrence of the ulcer I cannot say. The condition of his teeth and gums would account for infection and his habits for an abnormal condition of his gastric mucous membrane and secretions. Unfortunately, it is probably true that many if not most of our hospital patients cannot or will not eat as they should to avoid recurrence as long as they feel well.

CONCLUSIONS

The principal causes of the occasional failure of operative treatment to cure permanently gastric or duodenal ulcer are:

1. Improper technique.
2. Improper selection of cases.
3. Improper after-care and diet.
4. The failure to remove other causes of gastric symptoms.
5. The continued presence of the sources of infection.

Fortunately all these causes are remediable, so that in the future the results of the operative treatment of chronic gastric and duodenal ulcers should be far nearer perfect than they have been in the past.

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DUODENAL DIVERTICULA

With Report of a Case Associated With A Duodenal Ulcer[1]

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IN a review of the literature we have been able to find the reports of 76 well authenticated cases, in which 97 diverticula of the duodenum are described. In addition, roentgenologists have reported 11 cases in which 12 diverticula were present, some of which have been corroborated at operation. (Case, 1916; Stewart, 1916.) Only seven of the reported cases of diverticula of the duodenum occurred in the first portion.

Case, Carman (1916), and others report a sort of sacculation or pseudodiverticulum arising from a duodenal ulcer, scar, or periduodenal adhesions as due to gall-bladder disease. That the niche in duodenal ulcer is a rare condition is evidenced by the fact that Haudek and Carman have demonstrated it only twice, and George about six times (Eisen, 1916).

Previous to Bauer (1912) diverticula of the duodenum were considered from an anatomical standpoint only, as all of them, including his own, were demonstrated at necropsy. Since the diverticula were the indirect cause of the death of two of his patients, Bauer discusses the clinical symptoms. One having persistent vomiting and emaciation with pyloric insufficiency, due to traction or pressure, died from persistent emesis eleven days after a gastrojejunostomy. The other, a patient with jaundice, died from a hæmorrhage into an intrathoracic struma. At necropsy biliary stasis was found to be due to an inflammation of a diverticulum involving the ampulla of Vater. Baldwin (1911) has shown that diverticula of the duodenum, except in the first portion, are not relatively uncommon, since he discovered them in 15 duodena from 115 cadavers.

The clinical importance of the case we are reporting is in some degree lost because of its rarity as a surgical problem, and because pathological changes are very infrequent in diverticula of the duodenum. The interest lies, however, in the relation of the diverticulum to a duodenal ulcer, its position in the duodenum, its unusual size and its demonstration at operation. With the intention of presenting the cases of diverticula in the first portion of the duodenum, we have collected those reported heretofore.

Following are the descriptions collected from the literature, some of which are abstracted.

1. Morgagni (1761). This specimen, which was obtained from the body of a man who died of apoplexy, was situated two finger breadths caudal to the pylorus, the orifice being large enough to admit a finger. The sac exhibited no trace of pathological changes.

2. Rahn (1796) found a duodenal diverticulum in the emaciated body of a woman twenty-two years old who had died of chronic emesis. This sac-shaped diverticulum was closely related to the pylorus and presented a mucosal fold at its orifice not unlike that of the pylorus. The condition of gastroptosis was present in this cadaver.

3. Fleischmann (1815). Specimen 3, male, 28; drowned. The ductus pancreaticus and the ductus choledochus opened separately, each through a small duodenal diverticulum. Lying near these diverticula there was a third, the size of a pigeon's egg, and in the caudal first portion of the duodenum, still another smaller though similar diverticulum.

4. Albers (1844) mentioned one diverticulum located in the horizontal portion of the duodenum. It was scarcely one inch long and presented a contracted orifice with a marked fold of mucosa.

5. Jach (1899), specimen 2. Immediately caudal to the pylorus a cylindrical diverticulum with a mouth large enough to admit the thumb extended 3 centimeters caudally, dorsally, and medially from the first portion of the duodenum. Because of its cephalad position, this diverticulum had no relation either to the major duodenal papilla, though the opening of the diverticulum was on the same side, or to the head of the pancreas. The diverticulum was covered with loose connective tissue.

6. Jach (1899), specimen 3; male, 58; carcinoma of the rectum. In the first portion of the duodenum, 2.0 centimeters from the pylorus, there was an obliquely placed cicatrix. Between this and the pylorus an orifice large enough to admit one finger

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opened into a spherical diverticulum 1.0 centimeter deep, the fundus of which passed cephalad to the pylorus. Its dorsal surface was not connected with pancreatic tissue.

7. Falconer (1907), male 54; died of self-inflicted gunshot wound. A diverticulum was present arising from the greater curvature of the pyloric canal, ¾-inch long and ¾-inch in diameter. There was a smaller diverticulum just beyond the pylorus on the upper wall of the duodenum, ½-inch in diameter and ½ inch long. There was a ring of hypertrophied muscle, especially the circular muscle, but also the longitudinal, around both diverticula. A section of the diverticula showed all coats of the stomach and duodenum. There were no adhesions or signs of inflammation.

REPORT OF AUTHORS' CASE

This patient was subjected to the usual thorough routine examination, but all negative findings are excluded in this history.

Mrs. E. M. entered the University Hospital on the division of Dr. A. A. Law of the surgical service of Dr. J. E. Moore, June 10, 1916.

History. Age 32. Has one child, nine years old. The patient has been nervous and irritable the last two years. Occasional severe headaches. She does her own housework. Her weight varies; usually about 135 pounds; at present 145 pounds. She has always been bothered with indigestion. Her appetite is fair. In childhood, as far back as the patient can remember, she has had so-called bilious attacks, abdominal pains with nausea and vomiting, and on several occasions her mother told her she was jaundiced. At the age of eight years she had a very severe attack which kept her in bed for six weeks. From the age of eight to twenty years patient has had slight pains over right side of abdomen at intervals of six months or a year. These were colicky in character, not associated with nausea, vomiting, jaundice, constipation, or fever. There is no history of attacks of diarrhœa. At twenty a similar attack occurred as on previous occasions but exaggerated, the patient being confined to bed. From the age of twenty to two years before admission, the patient has had similar slight attacks, at intervals of six months or more. Vomiting has been only occasional, but nausea has been more frequent. For the last two years the symptoms have become more frequent and aggravated. The patient is not free of symptoms for more than two or three days at a time. Sometimes the pains have been colicky in character, starting over McBurney's point, radiating about the right lumbar region to the back. These pains last for about one and a half hours and the patient has to go to bed. No history of hæmatemesis or melæna. The patient sometimes wakes up at night with pain in the epigastrium. This pain lasts until the next meal, and is relieved by taking soda bicarbonate or food.

Physical examination. Patient is a well developed and well nourished woman. There is very definite muscle rigidity, spasm, and tenderness over the right of the epigastrium; more marked just to the right of the midline, 4 centimeters above the umbilicus. The stomach distended with gas reaches 5 centimeters below the umbilicus. Ewald one hour test meal before operation. Amount 40 cubic centimeters, dark brown. Total acid 72, free, 36, determined by using phenolphthalein and dimethylamido-azo benzol. The hydrogen ion concentration, determined by the gas chain method (by G. L. M.), equals $.26 \times 10^{-1}$ or p^{-H} equals 1.6. A roentgenogram (Fig. 1) was taken before operation.

Operation (by Dr. Ritchie), June 30, 1916. Right rectus incision. The stomach and duodenum were quite markedly distended with gas. On the anterior surface of the duodenum, near the superior margin, there was a stellate scar, slightly hæmorrhagic around its borders, typical of a chronic ulcer, which involved the portion just caudal to the pylorus. The pylorus was patent, admitting the tip of the index finger. Just below the pylorus on the lower side of the duodenum, there was a diverticulum, 5 centimeters in length and 3.5 centimeters in diameter, distended with gas. This was egg-shaped with a narrow isthmus that easily admitted the tip of the finger. Surrounding this opening into the sac was a hypertrophied ring of muscle. The wall of the sac was partially invaginated by plication. The scar of the ulcer was invaginated with a few Lembert stitches. A typical short loop posterior gastro-enterostomy was done, using interrupted linen and chromic catgut sutures.

The interesting points to be discussed are, the origin of the diverticulum, its relation to the duodenal ulcer, and the selection of operation.

Diverticula arise, according to Buschi, (1911), least frequently in the stomach, followed in order by the duodenum, pharynx, œsophagus, ileum, and colon.

Chomel (1710) first described a duodenal pocket in a woman eighty years old, situated at the junction of the duodenum with the bile-duct, and containing 22 stones. The first typical duodenal diverticulum was described by Morgagni (1761).

Diverticula have been classified by most authors as congenital and acquired. These may be subdivided into true and false. A true diverticulum presents in its walls all coats of the intestine. In the false variety the muscularis is wanting, the walls then being formed by mucosa and submucosa. The presence or absence of peritoneum depends upon whether the diverticulum is on the free surface or on the mesenteric border,

projected between the two layers of mesentery. Both true and false diverticula may be produced by traction from tumors of adherent organs, in ptosis especially by the ductus choledochus (Keith), by scar tissue or atrophy of the pancreas (Roth, Edel).

Klebs (1869) considered false diverticula as herniations of mucosa through the muscularis produced by traction on the mucosa, by blood-vessels piercing the muscularis. This relation of diverticula to the blood-vessel has been corroborated (Edel, Hansemann, Hanau, Davis, Gordinier and Sampson, and Fischer), although pulsion has been found of more importance in its origin than traction. These writers describe pulsion diverticula of the false variety as hernial protrusions of the mucosa related to the veins along the mesentery, perhaps associated with some predisposing cause, as muscular weakness. Graser, in addition, emphasizes the relation of the non-mesenteric false diverticula to the veins. He states that a relaxation of the venous sheaths is produced by blood-vessel stasis, which predisposes to diverticula.

These authors noted further that in experimentally produced diverticula by filling the intestines of cadavers with water, they ruptured regularly into the mesentery. Chlumsky (1899) found upon the living animal, contrary to the previous results, that the rupture occurred opposite to the mesentery — never into it — but that ten or more hours after death the intestines ruptured into the mesentery. Beer (1904) says there is no weak place at the mesentery, and that Chlumsky's results are corroborated by clinical findings in ileus where the peritoneum and muscle, usually the circular, tear first opposite to the mesentery.

Beer and Telling (1908) state there must be a change in the resisting powers of the intestinal wall, because diverticula exist particularly in old people whose intestines are more or less worked out; therefore, there must be a muscular weakness which accounts for the diverticula. Large areas of weak muscle wall form true diverticula; small areas, the false. These findings, the authors state, correspond to the close relation of the blood-vessels to the diverticula, the venous sheaths

Fig. 1. June 20, 1916. Before operation. The shadow of the diverticulum is shown arising from the duodenum just below the pylorus.

simply point the way. Wilson (1907) describes areas of marked thinning of the muscle even where no diverticula had developed. Relaxation of the duodenum and fatty degeneration of the muscularis have also been advanced as predisposing causes (Roth, 1872).

Several factors point to a congenital origin for true diverticula of the duodenum. In most of them there is an absence of any pathology such as ulcers, tumors, stones, worms, adhesions, or changes in the intestines, liver or pancreas. A case of Shaw, cited by Buschi, was undoubtedly congenital with atresia of the duodenum. In embryos of thirty to sixty days the duodenal lumen is normally more or less obliterated. The proliferation of epithelium early produces vacuoles or pits. The outer surface of the epithelial tube is generally smooth but frequently the masses of cells surrounding the vacuoles produce local bulgings of the basement membrane. Later the vacuoles confluesce to re-establish the lumen (Keibel and Mall, 1912).

The case which we report is exceptional because of the presence of a large evident

Fig. 2. This roentgenogram was taken three weeks after operation and shows a half moon shadow in the region of the diverticulum. A posterior gastrojejunostomy was done with a partial plication of the diverticulum.

Fig. 3. Three months after operation. The diverticulum is well filled with bismuth.

duodenal ulcer, which though entirely separate must be taken into consideration when discussing the cause of the diverticulum. The history goes back to early childhood which suggests the possibility of congenital origin. It is readily conceivable that a diverticulum in any part of the duodenum may find its beginning in one of the embryonal vacuoles which failed to confluesce. The internal pressure of fluid may in time cause this vacuole to become pathological.

Buschi, however, observes but little tendency to the formation of diverticula by internal pressure from stasis because of the fluidity of duodenal contents, and believes that stasis would need to be of high grade in order to produce them.

The opening of the diverticulum was nearly but not exactly opposite to the ulcer. Recent studies in roentgenography by Carman (1916) show that in duodenal ulcer a spastic incisura of the duodenal bulb, produced by a spastic contraction of the circular muscle fibers in the plane of the ulcer, is frequently shown in the roentgenograms as an indentation of the opposite curvature. We suggest that this spastic incisura as well as the relaxation of the duodenum with ptosis would be predisposing to the development of a diverticulum, particularly cephalad to the incisura. Such an explanation would fit our case and could, we believe, be applied to the third specimen of Jach's (1899), where there was an oblique cicatrix 2 centimeters from the pylorus, and between these, arose the diverticulum.

SELECTION OF OPERATION

The situation presented a nice surgical problem. An excision of the sac was first considered. The opening of the diverticulum was found on the under and lower side of the duodenum, which would lead the operative field toward the pancreas and at the lower end of the sac to a point extraperitoneal. It would have involved removing some part of the lower side of the duodenum without the possibility of re-covering with peritoneum. Since reviewing the anatomy and the several theories of origin, the possible close association with blood-vessels would have rendered such excision a dangerous procedure owing to the possible interference with blood supply to the duodenum. The deciding point at the time against excision was chiefly a mechanical

one of reperitonization. A Finney pyloroplasty would have led the opening of the stomach into the sac and it was impossible to get far enough under to attain a good peritoneal base, while the m.m. suture would have gone through tissues of questionable viability. A pylorectomy would have been the proper procedure, and though we desired the specimen, another mechanical obstacle arose; the question of room for invagination of the duodenum, without involving the ampulla. Possibly this objection was fanciful, but as the sac extended for two inches along the side wall of the duodenum, such a catastrophe had to be considered. There was also in view of the higher mortality of pylorectomy, the probability that more conservative measures would be sufficient. These were undertaken as above described.

Subsequent history. An immediate and uneventful recovery followed the operation. On the twenty-first day, the second roentgenogram was taken (Fig. 2), and shows the diverticulum obliterated except for a half moon shadow, which may be interpreted as a part of the cavity still open. Symptomatically, the patient at this time, three months following, has not been so free from pain and discomfort in years. The third roentgenogram (Fig. 3) was taken three months after operation. Other roentgenograms, four hours after a barium meal, made at this time showed a portion still remaining in the stomach and a small oval shadow in the region of the diverticulum. Immediately following was an attack of nausea and vomiting of acid stomach contents. This was quite transient and relieved by antacids, but may be a precursor of future trouble.

In conclusion we will outline briefly the unusual features of the case. First, that the diverticulum was demonstrated at operation; second, the unusual size, it being one of the largest reported; third, the position in the first portion of the duodenum just below the pylorus; and the last and most important feature, that it is the only case reported where a diverticulum was found in close proximity to an ulcer of the duodenal bulb.

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TUBERCULOSIS OF THE STOMACH, WITH REPORT OF A CASE OF MULTIPLE TUBERCULOUS ULCERS

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From the Mayo Clinic

TUBERCULOSIS of the stomach was encountered only once in a series of 2501 gastric operations in the Mayo Clinic from the years 1912 to 1915 inclusive. The fact that in this instance resection was done supposedly for carcinoma with partial obstruction stimulated the following investigation of the literature.

HISTORICAL

As nearly as could be ascertained, tuberculosis of the stomach was first mentioned by Barkhausen in 1824. From this date to the discovery of the specific organism by Koch in 1882 a fair number of cases was reported, the best report being that by Litten in 1876. Litten's description is nothing short of classical. His case presented a single ulcer 4.2 cm. by 3.2 cm. on the anterior wall, in the region of the lesser curvature, which on microscopic examination showed typical caseating tubercles with giant cells containing peripherally-situated nuclei.

In 1878 Breus gave a good gross and microscopic description of a case with ulcers and pyloric stenosis resulting from a firm scar. In 1879 a good gross and microscopic description was published by Talamon of a case in a female child 4½ years old with seven ulcers scattered over the mucous surface from cardia to pylorus. In 1881 Eppinger reported two interesting cases, both those of males, 30 and 55 years of age. A good gross and microscopic description (see miliary tuberculosis under types of lesions) accompanied this report also.

Regardless of the thoroughness with which the above-mentioned cases have been described, however, there is a certain element of doubt as to a positive diagnosis of tuberculosis because of the fact that the bacillus of tuberculosis was not discovered until 1882. The first to demonstrate the specific organism in the walls of a gastric ulcer was Coats in 1886. Thereby he eliminated all doubt as to the etiology of the lesion. Since that time the specific organism has been demonstrated in a fair number of cases. It was first accomplished in the United States by Musser in 1890.

While from time to time a fairly large number of cases has been reported, the majority will not stand when put to a critical test. Kuehl in 1889 reported 7 cases; 5 of the ulcer type and 2 with tubercles. He demonstrated the tubercle bacillus in 2 cases, 1 of each type. He also mentioned 7 other cases, but a microscopic examination was not made. In 1897 Hamilton, after a critical but incomplete review of the literature, was able to find only 15 positive and 9 probable cases, to which she added 3 positive cases. Blumer in 1898 collected 30 authentic cases from the literature to which he added 1 positive case. Simmonds in 1900 reported 8 ulcer cases and 4 of the miliary tubercle type. Glaubitt in 1901 reported 47 cases (40 of the ulcer type and 7 with tubercles) from 12,528 necropsies, 2,237 of which were tuberculous, i.e., 0.38 per cent of the total number of cadavers and 2.1 per cent of those that were tuberculous. Przewoski in 1902 reported 5 cases of tuberculous gastric ulcer, in all of which the tubercle bacillus was present. In 1902 Arloing reported 147 cases he had collected from the literature with the exception of 1 personal case. Ricard and Chevrier in 1905 collected 107 cases in which the findings in 16 cases of tuberculous pyloric stenosis were reported. Four of these were personal cases. The authors of the two latter reports were not very critical and accepted a good many cases that should have been rejected or classified as doubtful.

TYPES OF LESIONS

After a thorough review of the literature it will be found that gastric tuberculosis may

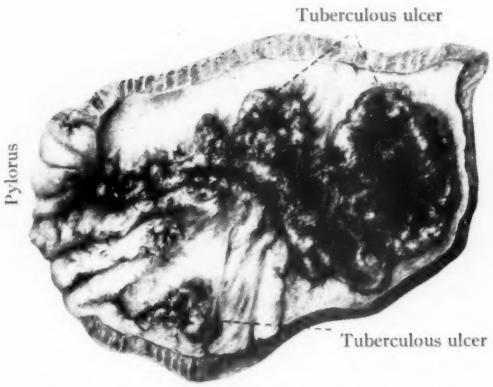

Fig. 1. Case 152198. Multiple tuberculous gastric ulcers. Drawing of gross specimen.

Fig. 2. Case 152198. Photograph of gross section shown in Fig. 1.

be divided into 6 types as follows: (1) ulcer (single or multiple); (2) miliary tubercle; (3) solitary tubercle; (4) pyloric stenosis; (5) tumor or nodule (single or multiple); and (6) lymphangitis.

1. *Ulcer (single or multiple).* There is practically no difference between the tuberculous gastric and the tuberculous intestinal ulcer. Tuberculous gastric ulcers range in size from the slightest erosion to 20 cm. by 10 cm. (Glaubitt). Some are very shallow; others very deep, extending through to the serosa and even perforating. They vary in number from a single ulcer to large numbers. In her first case Hamilton reported from 115 to 120. Sometimes they are associated with miliary tubercles.

2. *Miliary tubercles.* Miliary tuberculosis of the stomach is usually associated with a general miliary tuberculosis. An interesting case of this type was reported by Wilms in a child 9 months old. Wilms holds that miliary tuberculosis of the stomach may be frequently associated with general tuberculosis; that the postmortem changes in the stomach mucosa twelve or twenty-four hours after death are such as to obscure the miliary tuberculosis. Simmonds believes that miliary tuberculosis of the gastric mucous membrane is not a rare occurrence.

In one of Eppinger's cases, tuberculous ulcers and miliary tubercles of the stomach were associated with chronic tuberculosis in the upper lobe of the right lung. In the other case there was an old tuberculosis in the apex of the right lung, miliary tuberculosis of both lungs and liver, and tuberculous ulcers in the stomach. Eppinger concluded that in both cases the gastric tuberculosis was of a general acute type.

3. *Solitary tubercle.* The solitary tubercle is very rare. Van Wart reported an interesting case in which the tubercle, 3.5 cm. in diameter, was located 6 cm. from the cardiac orifice on the greater curvature. The same patient had small simple ulcers near the pylorus, chronic peritonitis, chronic pericarditis, chronic pleuritis and bronchopneumonia. It was not possible to demonstrate tuberculosis in any organ other than the stomach. Van Wart concluded: "It is impossible to state whether the lesion was primary in the stomach, but there is no definite evidence to the contrary."

Another interesting case was reported by Barchasch. In this instance a solitary tubercle of the stomach was associated with tuberculosis of the lungs and lymph glands and carcinoma of the cardia of the stomach and œsophagus.

4. *Pyloric stenosis.* Tuberculous stenosis of the pylorus is of two types: the true and

Fig. 3. Case 152198. Photomicrograph of section of large ulcer at juncture of base and border, showing one definite and three indefinite tubercle (slow power).

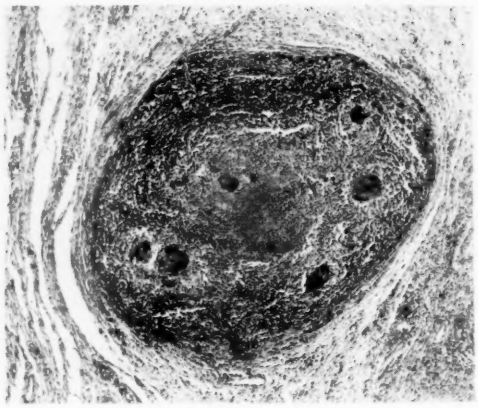

Fig. 4. Case 152198. Definite tubercle, Fig. 3, showing six giant cells (high power).

the false. The true type includes cases in which the pylorus is obstructed by an old tuberculous ulcer with an excessive amount of scar tissue and tuberculous granulations or by a diffuse nonulcerative tuberculosis of the pylorus. A large number of cases have been reported as tuberculous stenosis of the pylorus when as a matter of fact they should come under the false type, the tuberculous process being extragastric. The stenosis of this type is brought about by enlarged tuberculous peripyloric lymph glands, or by a tuberculous peritonitis in the region of the pylorus accompanied by adhesions often involving other organs in the process. Both types have been described by Ricard and Chevrier.

5. *Tumor or nodule (single or multiple).* A case of this kind was described by Cone, in which there were three types of nodules with a general acute miliary tuberculosis. The first type was due to a connective-tissue overgrowth or to irregular fibrous contraction and the second to an atypical glandular growth. The third was specifically tuberculous.

6. *Lymphangitis.* Reports of tuberculous lymphangitis of the stomach are rare. A good case has been described by Dewey — that of a man 45 years of age, who had, in addition to the gastric tuberculous lymphangitis, tuberculosis of the lungs, tuberculous tracheobronchial lymph glands and tuberculous ulcerative colitis. He was extremely emaciated, weighing only 64 pounds.

MODE OF INFECTION

The stomach may be infected with tuberculosis by at least four routes: (1) the mucosa (direct infection); (2) the blood stream; (3) the lymphatic system; and (4) continuity and contiguity of structure.

It is safe to say that infection of the normal mucosa of the stomach is difficult. However, it seems reasonable to conclude that a lesion associated with reduced acidity renders such infection easier. It is a well known fact that a good many tuberculous patients are afflicted with disease of the stomach.

Marfan found a terminal gastritis in 18 of 27 phthisical patients. A fair number suffer from simple gastric ulcers, such as the cases of Papellier (3 cases), Chambers, Cruveilhier, Toulmouche (5 cases), Heine, and others.

Happel and Blumer reported a case of advanced pulmonary tuberculosis accompanied by round ulcers of the stomach and an absence of free hydrochloric acid. While a microscopic examination of material scraped from the bases of the ulcers showed many tubercle bacilli, it was impossible to demonstrate the bacilli in the depths of the ulcers

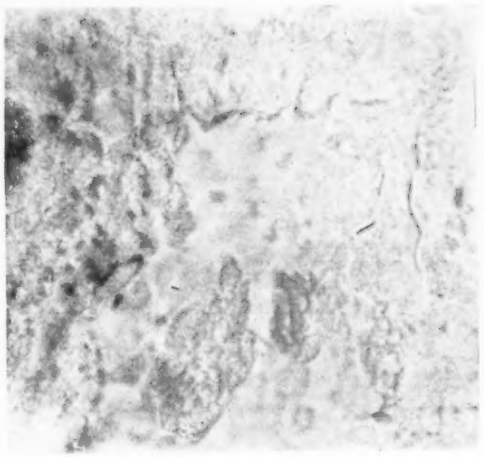

Fig. 5. Case 152198. Tubercle bacillus in the depths of the large gastric ulcer (1400 diameters).

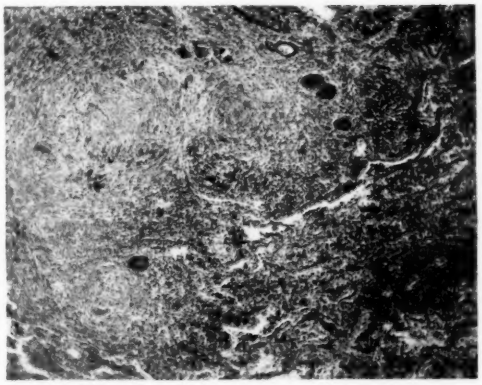

Fig. 6. Case 152198. Photomicrograph of section of the apex of the left lung, showing giant cells, necrotic areas, scar-tissue and round cells.

or to find an histologic picture of tuberculosis. This case proves that in the absence of free hydrochloric acid, tubercle bacilli may come in contact with an eroded area of the stomach and still not produce tuberculosis of the organ.

Cases have been reported in which the stomach was affected with both tuberculosis and cancer (Claude, Barchasch, second case, Lyle, Borst and Simmonds). In such instances it seems that it would be rather difficult to prove which was there first.

Various writers ascribe the gastric tuberculosis in the cases they report to the swallowing of sputum containing tubercle bacilli (Kuehl, 7 cases; Ellis, first case; and others).

Duerck states that in order to infect the mucosa a break in the continuity of the mucosa and a neutralization or a lessening of the acidity of the gastric juice are necessary. According to Birch-Hirschfeld tuberculosis of the gastric mucosa may occur only when active tubercle bacilli attack an eroded area. Hamilton suggested that in her second case ecchymoses may have been the forerunners of the small erosions, the tubercle bacillus being responsible only secondarily for the further destruction. Wilms states that gastric ulcers may occur in the absence of tubercle bacilli, being due to embolic plugs in the vessels.

According to Arloing, the blood stream is the most probable route of infection. He bases his opinion on the results of experimental work. Other authors also believe this to have been the route of infection in their cases (Cone, Wilms, Simmonds, 4 cases).

According to some writers the lymphatic system plays an important part in gastric tuberculosis. Baumgarten believes that tuberculosis of the stomach always begins in the lymph follicles, never in the mucosa or any other part of the wall.

Wilms states that in the stomachs of children lymph follicles are very few in number, though they increase in adults; he also states that in his case the follicles were not responsible. Barbacci considered the lymph follicles the primary seat of infection. Dobrowolski has shown that the lymph follicles are not always so few in the human stomach. In catarrhal gastritis they are markedly increased and he has applied to this condition the term "gastritis granulosa" (see Marfan, under Mode of Infection).

That tuberculosis may enter the stomach from adjacent tuberculous lymph glands is evident from the case of Claytor and Wilkinson, in which the tuberculous glands were intimately fused with the base of a tuberculous gastric ulcer. Chiari had a similar case. Rosset thought that in his case the tuberculosis was primary in the lymph

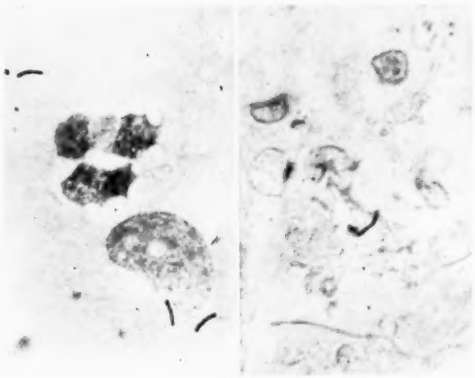

Fig. 7. Case 152198. Tubercle bacilli in smear from surface of the left lung (1800 diameters).

Fig. 8. Case 152198. Two tubercle bacilli in the depths of the lung tissue, end-to-end (1600 diameters).

glands at the hilus of the left lung and that it infected the retrogastric lymph glands and then the stomach by a blockade of the lymph stream. This patient had a tuberculous ulcer of the cardia.

Tubercle bacilli may enter the lymphatics of the stomach and set up a tuberculous lymphangitis, as was proved in Dewey's case by the finding of the bacilli in the lymph vessels and tuberculous ridges following the lines of these vessels.

Infection by continuity and contiguity of structure is believed by some to be important.

Rokitansky stated that tuberculosis of the stomach occurs as a result of intestinal tuberculosis which has advanced to an extreme degree (continuous involvement). In his opinion the lymph glands of the stomach bear the same relation to tuberculosis of that organ as the mesenteric glands bear to tuberculosis of the intestines. His first statement has not proved entirely correct as cases of gastric tuberculosis have been described in which the intestines were entirely free from tuberculosis (Litten, Eppinger, 2 cases, Brechemin, Mathieu and Remond, Van Wart, Lyle, Gossmann, and the writer).

Duerck stated that very probably a large number of the reported cases of tuberculous ulceration of the stomach are due to the entrance of the bacilli, not from the inside, but from the peritoneal surface, because of a general or local peritonitis. Ellis' second case is an example.

It is possible for the stomach to become infected with tuberculosis by direct extension from adjacent organs such as occurred in the case reported by Winternitz.

In a number of instances infections by the lymph stream and by continuity and contiguity of structure are indistinguishable.

RELATIVE IMMUNITY

In 1879 Orth, by feeding tuberculous material to rabbits, was able to produce tuberculosis in various parts of the body. The lymph glands were involved 7 times out of 9. In the stomach he found hæmorrhagic erosions twice, and an ulcer once. This ulcer was only 7 or 8 millimeters in diameter. From his microscopic description, it seems that the ulcer was not tuberculous.

In 1883 Falk took particles from tuberculous lungs and caseous particles and pus from cavities, immersed them in the digestive juices, and injected them into the peritoneal cavities of guinea pigs. The result, except for a local reaction, was negative. He then allowed the tuberculous material to putrify and still obtained a negative result. Next, he took tuberculous material from bodies that had been dead for eight days and kept at medium temperature but found that it had lost its virulence to a certain degree. He produced tuberculosis by injecting into a guinea pig a piece of tuberculous material which had been obtained from a cow and soaked in gastric juice for several days.

Frank in 1884 took small pieces of tuberculous lung, let them stand in water for twenty-four hours, stained some of the fluid with Ehrlich's stain and found tubercle bacilli in great numbers. He then made up the following solutions with the solution containing the tubercle bacilli: (1) 1 to 1000 pepsin; (2) 1 to 2000 pepsin plus 0.05 of 1 per cent to 0.1 of 1 per cent HCl; (3) 0.05 to 0.1 per cent HCl; and (4) 0.3 of 1 per cent bile.

The above solutions were incubated at from 37 to 38° C., and after from one to six hours, 5 to 8 cubic centimeters of each were injected into the peritoneal cavities of rabbits and guinea pigs. At the same time some of

the original solution was injected into rabbits as a control. Those that died before seventeen days after inoculation showed no tuberculous infection. After that time they showed definite symptoms and all that were killed or died after six weeks showed general tuberculosis. The strength of the formulas was increased with the same result. According to Frank, these experiments showed two facts: (1) that the material was really infectious; and (2) that pepsin, HCl, and bile had no effect.

Sormani in 1884 concluded that the bactericidal action of gastric juice on tubercle bacilli is efficient and that gastric diseases cause this action to disappear.

Wesener in 1885 placed tuberculous particles in artificial gastric juice at 38° C. for some hours. He then inoculated the cæcum of rabbits, obtaining positive results. Five injections of the same material into the anterior chamber of the eye also proved positive.

Fischer in 1886 concluded that the gastric juice is inefficient.

Zagari in 1889 fed dogs for three or four months on material containing many bacilli that had been obtained from phthisical patients; he fed them also organs from tuberculous animals. He recovered numerous bacilli in the fæces that were active for guinea pigs. In his opinion the bacilli went through the digestive tube of the dog without noticeable change because of their short stay in the stomach. *In vitro* and at 38° C. the bacilli put in contact with the gastric juice of a dog containing 0.1652 free HCl per 1000 for three or four hours were still very virulent. After seven, eight, and nine hours they produced only a local glandular tuberculosis, and after eighteen to twenty-four hours of contact, they were without action.

Straus and Wuertz in 1889 mixed *in vitro* pure gastric juice of a dog with a young and virulent culture of tubercle bacilli. Tubes containing 1 cubic centimeter of gastric juice mixed with the culture were put in an oven at 38° C. for a time varying from one to forty-eight hours. Rabbits that were inoculated by the contents of tubes that had remained in the oven from one to six hours died with generalized tuberculosis; those that were inoculated with the contents after eight to twelve hours in the oven developed only a local abscess without any tendency to generalization (the bacilli were dead or attenuated). The bacilli lost all activity if they remained in the oven more than eighteen hours.

Kurloff and Wagner in 1890 added to artificial gastric juice, tubercle bacilli from cultures or tuberculous masses and placed the bacilli in the stomachs of dogs through previously made fistulas. The results were negative even after seven hours of contact.

In 1896 Kjianowski arrived at the same conclusion as to the viability of the bacilli.

Schoull in 1891 proved that the gastric juice of cats is not bactericidal.

Cadéac and Bournay in 1893 at the Veterinary School of Lyons conducted experiments to ascertain the bactericidal action of the digestive juices and the possibility of contagion by fæcal matter. They found that digestion *in vitro* had not the same value as digestion in life. It was their aim to approach the natural means of contagion. They believe that the bactericidal power of the gastric juice *in vivo* is considerably modified by dilution with fluids, absorption by food and neutralization by saline substances. Their experiments demonstrated the complete inefficiency of the gastric juice.

Carrière in 1901 found that artificial gastric juice mixed *in vitro* at 37° C. with three to twenty-four hour cultures of tubercle bacilli or in milk particles or food containing the bacilli, remained without action on them if the contact did not last at least twelve hours. After twelve hours the food was still tuberculigenic, the bacilli being only attenuated, not killed. He took gastric juice from a healthy man, added the same infected particles to it for twelve hours at 37° C. with the result that the virulency of the bacilli was attenuated.

Arloing in 1902 performed 3 series of experiments on 30 animals (2 calves, 13 dogs, 1 sheep, 11 rabbits, and 3 guinea pigs). In his first series he introduced human tubercle bacilli from a young culture by injecting them into the stomach through a fistula or inoculating them into the mucosa of the

organs of 7 animals. The experiments lasted from two to two and a half months and were terminated most often by the sacrifice of the subject; more rarely by death. In this series Arloing increased the acidity of the gastric juice, introduced alkaline solution into the stomach, ligated 5 or 6 arteries along the greater curvature from cardia to pylorus, produced mechanical ulcerations of the mucosa with the electric needle and also an ulceration of the mucosa by the injection of an emetic before introducing the bacilli. He was unable to produce a tuberculous gastric ulcer in a single instance.

In his second series he utilized the intravascular method of injecting the tubercle bacilli, using 1 calf, 2 dogs and a rabbit. Gastric ulcers resulted in all of the animals but they were not definitely tuberculous. He was able to produce 2 tuberculous duodenal ulcers in 1 of the dogs. All of the animals in this series showed polyvisceral miliary lesions.

In his third series he introduced human bacilli in all cases by interstitial inoculation of the stomachs of 1 calf, 1 sheep, 4 dogs, 10 rabbits and 3 guinea pigs. In the stomach of the sheep he found a tuberculous mass filled with tubercle bacilli at the point of injection. In 1 of the dogs he produced a typical tuberculous gastric ulcer with tubercle bacilli in its subjacent tissue. He was able to produce the types of tuberculous ulcerations found in man twice in 30 animals, once in the stomach and once in the duodenum, both times in dogs. The first time injection of the bacilli into the blood stream produced tuberculous ulcers of the duodenum and the second time injection into the wall of the stomach produced a tuberculous gastric ulcer.

Various theories have been advanced regarding the relative immunity of the stomach to tuberculosis. Some of these are as follows:

Duerck believed that the stomach is protected fairly well in normal persons by the strong acidity of its juice but that tubercle bacilli are not killed by this strong acid as is proved by the prevalence of intestinal tuberculosis and by many experiments.

Virchow ascribed the rarity of gastric tuberculosis to the sparsity of the lymphatic supply of the stomach wall. Klebs ascribes its rarity to the sparsity and deep-seated location of the lymph follicles. Kanzow states that the main reason is not only the sparsity and the deep location of the lymph follicles but an intact condition of the epithelium and the relatively short stay of the ingesta in the stomach. Struppler also believes that the intact epithelium acts as a protection against tubercle bacilli, although he admits that they may attack the lymph follicles without injuring the epithelium. In Simmonds' opinion the normally secreting mucosa plays an important rôle.

Other organs are known to be relatively immune to tuberculosis: the thyroid, salivary glands, œsophagus, pancreas, gall-bladder, ovary, uterus, and heart.

Arloing mentioned the resistance of muscle tissue to tuberculosis. Probably such resistance accounts for the relative immunity of the uterus and heart, muscle being the predominating tissue in both.

CLASSIFICATION OF CASES

In order to draw correct conclusions from the cases that have been reported in the literature, it is necessary to make a classification from a critical standpoint. For convenience the cases are grouped under four classes: (1) positive; (2) probable; (3) doubtful; and (4) rejected. The qualifications for each class are as follows:

1. *Positive.* All cases that contain an histologic picture of tuberculosis plus the presence of the bacillus of tuberculosis in the depths of the lesion or the presence of the specific bacillus in the depths of an indefinite histologic lesion.

2. *Probable.* All cases that possess an histologic picture of tuberculosis.

3. *Doubtful.* All cases with a good gross description of tuberculosis or a good gross description plus a poor histologic description.

4. *Rejected.* All cases that cannot meet the qualifications of the three preceding classes, such as those regarding which is given a clinical diagnosis only, a poor gross description, or a poor gross and microscopic description, cases in which the tubercle

bacillus was present on the surface of the lesion unaccompanied by a positive histologic picture, cases regarding which the authors state the nature of the condition without substantiating their claims, the false type of tuberculous pyloric stenosis, etc.

CLASSIFICATION OF CASES

Author	Positive	Probable	Doubtful	Rejected
Alessandri	..	1	..	..
Alexander	1	..	..	..
Andral	..	..	..	2
Anger	..	..	1	..
Arloing	..	..	1	..
Barbacci	..	1	..	..
Barchasch	1	1	..	..
Barkhausen	..	..	..	1
Barlow	..	..	1	..
Baron	..	..	..	1
Barth	..	1	..	..
Batsère	..	1	..	..
Beadles	..	1	..	..
Bednar	..	..	..	1
Beneke	..	..	1	..
Besnier	..	..	1	..
Bignon	..	..	1	..
Blas	1	3	..	..
Blumer	1	..	..	..
Borst	1	..	..	..
Brechemin	..	1	..	..
Breuer	..	..	..	1
Bieus	..	1	..	..
Cazin	..	..	1	..
Chalier and Nové-Josserand	..	1	..	..
Chevassu	..	..	..	1
Chiari	..	1	..	..
Chvostek	..	..	4	..
Clairmont	..	..	..	2
Claude	1	..	..	..
Claytor and Wilkinson	1	..	..	..
Coats	1	..	..	..
Cone	1	..	..	..
Curschmann	..	1	..	..
Czerny	..	1	..	..
DaCosta	..	..	1	..
Dauwe	..	..	1	..
DeVecchi	1	..	..	..
Devic	..	..	..	1
Dewey	1	..	..	..
Docq	..	1	..	..
Duguet	..	..	1	..
Durante	..	2	..	..
Ellis	2	..	..	..
Eppinger	..	2	..	..
Ferrari	..	..	..	1
Fischer (Erwin)	..	..	..	1
Fischer-Defoy	..	1	..	..
Fox	..	..	1	..
Frerichs	..	..	6	..
Frommer	..	..	..	2
Fujii	..	..	1	..
Gaillard	..	..	1	..
Gelpke	..	1	..	..
Glaubitt	1	46	..	..
Godart-Danhieux	..	..	..	2
Gossmann	..	3	..	1
Habershon	1	..	..	..
Hamilton	3	..	..	..
Hanau	..	..	1	..
Hattute	..	..	1	..
Hebb	..	1	..	..
Hecker	..	..	..	2
Herczel	..	1	..	..
Holt	3	..	2	..
Holzmann	1	3	..	..
Jacobs	..	..	..	1
Kanzow	..	1	..	..
Keen	..	..	1	..
Klebs	..	..	1	..
Kuehl	2	5	..	7
Kundrat	..	..	2	..
Labadie-Lagrave	..	..	..	1
Lancereaux	..	..	..	1
Lange	..	..	1	..
Lava	..	1	..	..
Letorey	..	1	..	..
Letulle	1	..	..	..
Leven	..	..	..	1
Lipscher	..	1	..	..
Lister	..	2	3	..
Litten	..	1	..	..
Lorey	..	..	1	..
Louis	..	..	..	1
Lyle	..	1	..	..
Margarucci	..	1	..	..
Mathieu	..	1	..	..
Mathieu and Rémond	1	..	..	..
Mayo-Robson and Moynihan	..	..	1	..
Melchior	..	6	..	..
Merry	..	..	..	1
Mouisset and Mouriquand	..	..	..	1
Mueller	..	..	..	5
Musser	1	..	..	..
Nash	..	..	1	..
Nordmann	1	..	..	..
Oppolzer	..	..	1	..
Papavoine	..	..	1	..
Patel	..	..	..	1
Patella	..	..	..	3
Paulicky	..	..	1	..
Petruschky	..	..	..	2
Pitt	..	..	..	1
Plambeck	..	..	..	3
Pozzi	..	..	1	..
Przewoski	5	..	..	..
Quénu	..	..	..	1
Reinhold	1	..	..	..
Rémon and Verliac	1	..	..	..
Ricard	..	..	1	1
Ricard and Chevrier	..	..	..	2
Rilliet and Barthez	..	..	..	21
Roger	..	..	..	1
Rosset	..	1	..	..
Ruge	1	..	..	..
Satterthwaite	..	..	..	2
Schede	1	..	..	..
Schlesinger	..	1	..	..
Serafini	1	..	..	..
Sigg	..	1	..	..
Simmonds	1	11	..	..
Steiner and Neureutter	..	..	4	..
Stelter	..	..	5	..
Still	2	1	2	..
Sokolowski	1	..	..	..
Struppler	..	..	1	..
Talamon	..	1	..	..

Author	Positive	Probable	Doubtful	Rejected
Thorel	3	1	1	..
Tichoff	..	1	..	..
Tripier	..	1	2	2
Vallas	..	1	..	..
Van Wart	1	..	..	..
Von Tappeiner	..	..	1	..
Weinberg	1	..	..	..
Widerhofer	..	..	..	2
Wilms	1	..	..	..
Winternitz	1	..	..	..
Personal	1	..	..	..
Total	49	118	59	80

STATISTICS COMPILED FROM POSITIVE CASES

Adults	33
Children	12
Not indicated	4
	49
Males	24
Females	14
Not indicated	11
	49

TYPES OF LESIONS

Single ulcer	14
Single ulcer and miliary tubercles	1
Single ulcer and nodules	1
Single ulcer and carcinoma	1
Multiple ulcers	19
Multiple ulcers and miliary tubercles	3
Multiple ulcers and carcinoma	1
Miliary tubercles	3
Solitary tubercle	2
Solitary tubercle and carcinoma	1
Tumors or nodules	2
Lymphangitis	1
	49

Total ulcer cases, 40 out of 49 (81.6 per cent).

LOCATION OF ULCER OR ULCERS IN ORDER OF FREQUENCY

Lesser curvature	10
Greater curvature	6
Pylorus	5
Posterior wall	3
General distribution	2
Cardia	1
Not indicated	13
	40

OTHER ORGANS INVOLVED, FINDINGS NEGATIVE, OR CONDITION NOT INDICATED

Lungs involved	34
Lungs not involved	5
Not indicated	10
	49
Intestines involved	29
Intestines not involved	3
Not indicated	17
	49
Lymph glands involved	26
Negative or not indicated	23
	49
Peritoneum involved	12
Negative or not indicated	37
	49
Liver involved	10
Negative or not indicated	39
	49
Kidneys, one or both involved	10
Negative or not indicated	39
	49
Spleen involved	8
Negative or not indicated	41
	49
Tuberculosis and carcinoma of the stomach	3
Cases with perforation	5
Cases clinically diagnosed as carcinoma	4
Cases thought by author to be primary	2

STATISTICS COMPILED FROM PROBABLE CASES

Adults	75
Children	23
Not indicated	20
	118
Males	65
Females	34
Not indicated	19
	118

TYPES OF LESIONS

Single ulcer	18
Single ulcer and miliary tubercle	1
Single ulcer and carcinoma	1
Multiple ulcers	19
Multiple ulcers and nodules	1
Multiple ulcers and miliary tubercles	4
Multiple ulcers and carcinoma	1
Ulcer cases, number not indicated	50
Miliary tubercles	12
Tumors or nodules	7
Diffuse tuberculosis of pylorus	3
Lesion not indicated	1
	118

Total ulcer cases, 95 out of 118 (80.5 per cent).

LOCATION OF ULCER OR ULCERS IN ORDER OF FREQUENCY

Pylorus	11
General distribution	5
Lesser curvature	3
Posterior wall	3
Cardia	3
Greater curvature	2
Anterior wall	1
Not indicated	67
	95

OTHER ORGANS INVOLVED, FINDINGS NEGATIVE, OR CONDITION NOT INDICATED	
Lungs involved	102
Lungs not involved	2
Not indicated	14
	118
Intestines involved	82
Intestines not involved	6
Not indicated	30
	118
Lymph glands involved	51
Negative or not indicated	67
	118
Liver involved	41
Negative or not indicated	77
	118
Kidneys, one or both involved	34
Negative or not indicated	84
	118
Spleen involved	25
Negative or not indicated	93
	118
Peritoneum involved	19
Negative or not indicated	99
	118
Œsophagus involved	4
Negative or not indicated	114
	118
Tuberculosis and carcinoma of the stomach	2
Cases with perforation	5
Cases clinically diagnosed carcinoma	2
Cases thought by author to be primary	2

The tuberculous process has been considered primary in the stomach 4 times (Lava, Ruge, Fischer-Defoy and Van Wart). Lava's patient had tuberculosis of the intestines and lymphatic glands in the pyloric region accompanied by an acute diffuse sero-fibrinous peritonitis and a chronic peritonitis. Ruge's patient had tuberculosis of the pleura, intestine, peritoneum, right kidney and of the omental, para-aortic and inguinal lymphatic glands. In the case described by Fischer-Defoy there was tuberculosis of the lungs, intestines, and lymphatic glands of the lesser curvature of the stomach and in the region of the liver. According to the author the older process was in the stomach and intestinal tract but there was no exact proof that it was primary in the intestine. Van Wart was unable to demonstrate tuberculosis in any other part of the body, although the patient had chronic peritonitis, pleuritis, and pericarditis. It was impossible to state whether the lesion was primary in the stomach, but there is no definite evidence to the contrary.

The cases of the first three authors cited should not be classified as primarily gastric. The only case which could be considered primary in the stomach is that of Van Wart who stated: "The autopsy revealed no other definite tuberculous lesion, but the nature of the process giving rise to the peritonitis, pleuritis, and pericarditis, must be considered."

No case of tuberculosis should be considered primary in the stomach unless a thorough search does not show any evidence of the disease in any other part of the body.

CASE REPORT

F. P., male, age 42 years; brick layer; married 11 years. One child who died at the age of one year from meningitis. Patient had had no previous diseases of note. Chief complaint stomach trouble. Operated on six months previously elsewhere; incision closed; diagnosis of inoperable carcinoma of stomach. *Clinical history.* The trouble began two years previously with a feeling of heaviness in the epigastrium which came on from one-half to two hours after meals. Six months later he began to have attacks of vomiting every two or three days from two to three hours after meals. Nine months previous to coming for examination he ceased vomiting for two months but there was no cessation of the epigastric distress. Six months previously there was recurrence of vomiting, almost daily, about one-half an hour after meals. The patient lost weight rapidly. Six months prior to coming to the Clinic an exploratory operation was done after which there was some improvement for five months. For the past three weeks regurgitation occurred as soon as food was taken. The patient could retain eggnog. He never had severe pain or sour stomach. Always felt hungry. *Physical examination.* Nothing of note except a mass in the right side of the upper abdomen. *Pre-operative laboratory findings:* Hæmoglobin 70 per cent, erythrocytes 4,760,000. Test meal: total acidity 12, all combined; food remnants 1 on a basis of 4; filtrate 150 cubic centimeters. Oppler-Boas 1 on a basis of 4. *Roentgenologic report:* carcinoma of stomach, operable. *Clinical diagnosis:* carcinoma of the stomach. *Operation:* Polya resection; about one-

third of stomach removed; high midline incision (E. S. Judd). Tumor of stomach near pylorus; marked spasm but stomach not dilated.

Postoperative laboratory findings: macroscopic. Pyloric third of stomach containing three yellowish-brown ulcers with ragged edges and dirty rough bases on mucous surface (Figs. 1 and 2). The larger ulcer extends from a point 1.5 cm. from the pyloric ring upward on the greater curvature for 7 cm. It is 4 cm. in width. The two smaller ulcers are 1 cm. in diameter. One is situated 2.5 cm. from the pyloric ring and 7 cm. from the large ulcer; the other is 3 cm. from the pyloric ring and 3 cm. from the large ulcer.

Microscopic. Sections from all of the ulcers show typical tubercles with characteristic giant cells, extending down to the musculature (Figs. 3 and 4). Paraffin sections stained by the Ziehl-Neelsen method show a few scattered tubercle bacilli in the depths of the ulcers (Fig. 5). A thorough search for spirochætæ was made but the findings were negative. A few of the lymphatic glands attached to the resected portion of the stomach are slightly enlarged and on gross section are of a yellowish-brown color. Microscopically they show typical tubercles and giant cells. These glands apparently are in the precaseous stage.

Three sputum examinations were all negative to acid-fast bacilli. Von Pirquet test negative. Complete blood count one day after operation: Hæmoglobin 82 per cent, erythrocytes 5,440,000; leucocytes 23,400; differential, total number 300; polymorphonuclear neutrophiles 88 per cent; small lymphocytes 10 per cent; large lymphocytes 1.7 per cent; basophiles 0.3 per cent. White blood count three days after operation: leucocytes 15,800; differential, total number 300; polymorphonuclear neutrophiles 90.3 per cent; small lymphocytes 6.7 per cent; large lymphocytes 3 per cent. White blood count six days after operation: leucocytes 9,200; differential, total number 300; polymorphonuclear neutrophiles 83.7 per cent; small lymphocytes 10.7 per cent; large lymphocytes 5.3 per cent; eosinophiles 0.3.

Wassermann test six days after operation. Total inhibition.

Patient died 11 days after operation. *Clinical cause of death.* Pneumonia.

Necropsy (one and one-half hours after death): An extremely emaciated white man about middle age; 5 feet, 8 inches in height, and weighing about 90 pounds. Findings negative except for an upper midline abdominal incision 14 centimeters long with edges in good apposition. On section of the thorax firm pleural adhesions at both apices and a recent fibrinous pleurisy over the lower lobe of the right lung were encountered. At the apex of the left lung was an area of old tuberculosis measuring 5 by 7 by 5 centimeters and characterized by fibrosed, dry and caseous tubercles. Throughout the remainder of this lung, as well as the lower lobe of the right lung, were scattered areas from miliary size to 2 centimeters in diameter, showing various stages of the tuberculous process. The peribronchial lymph glands were enlarged. The heart was small, weighing only 210 gm. Except for apparent myocardial degeneration, it was normal. About one-third of the pyloric end of the stomach had been resected and there was a clean anastomosis between the remainder and a loop of the jejunum. In the gastrocolic omentum were several hard nodules about the size of a pea, probably tuberculous glands. The retroperitoneal glands in the region of the stomach were enlarged. The intestines were absolutely free from tuberculosis. The liver showed a fairly marked fatty change. In the remainder of the abdominal viscera, the pelvic viscera, and the genitalia, there was nothing of note.

Anatomic diagnosis: Recent tuberculosis of the lower lobes of both lungs with an old tuberculous process in the left upper lobe. An acute fibrinous pleurisy of the right side and an old adhesive pleurisy of the left. Myocardial degeneration, fatty changes in the liver, and tuberculous lymph adenitis.

Microscopic examination. In the apex of the left lung was an old tuberculous process characterized by a marked fibrosis in addition to the typical picture of tuberculosis (Fig. 6). In sections from the depths of the lower lobes of the lungs stained by the Ziehl-Neelsen method numerous tubercle bacilli were found (Fig. 8). Sections from the peribronchial lymph glands showed typical tuberculosis not yet broken down. Sections from the remainder of the stomach showed no tuberculosis. Sections from the lymph glands in the gastrocolic omentum showed tuberculosis. The liver showed a marked fatty change. In the remainder of the organs there was nothing of significance. In a smear from a freshly cut surface of the lower lobe of the left lung stained by the Ziehl-Neelsen method were numerous tubercle bacilli (Fig. 7).

A Wassermann test from the blood at necropsy showed a total inhibition.

SUMMARY AND CONCLUSIONS RELATIVE TO THE CASE REPORT

1. The clinical history suggested a gastric ulcer or carcinoma.

2. There was no sign or symptom in the clinical history suggesting disease of the chest so completely did the gastric symptoms predominate.

3. The failure to detect the lesion in the apex of the left lung by the physical examination was probably due to the absence of cavity formation.

4. Three sputum examinations following the operation failed to throw any light on the pulmonary condition.

5. In all probability the source of infection in this case was the old tuberculous lesion in the upper lobe of the left lung.

6. The tuberculosis of the peribronchial lymphatic glands and the lymphatic glands adjacent to the

stomach were probably secondary to tuberculosis of the upper lobe of the left lung and the stomach respectively.

7. If the Wassermann test is infallible in the presence of advanced tuberculosis this patient had syphilis, but whether it was infallible or not, the outstanding fact is that the patient had gastric and pulmonary tuberculosis as was proved by a definite histologic picture and the finding of the bacillus of tuberculosis in the depths of the lesions.

GENERAL CONCLUSIONS

1. Little was known of gastric tuberculosis before the middle of the nineteenth century.

2. Gastric tuberculous lesions have practically the same gross and microscopic appearance as tuberculous lesions of the intestines.

3. A specific reason for the relative immunity of the stomach to tuberculosis still remains unknown.

4. The gastric juice appears to have a very slight effect on the tubercle bacillus unless the contact extends over a period of at least twelve hours.

5. It is possible to produce gastric tuberculosis experimentally.

6. The exact mode of infection is often difficult to determine.

7. The theory that gastric tuberculosis is always secondary to intestinal tuberculosis has been disproved.

8. About half of the cases reported as gastric tuberculosis should be classified as doubtful or rejected.

9. Adults are affected more often than children, the ratio being about 3 to 1.

10. Males are affected more often than females, the ratio being about 2 to 1.

11. Ulcer is the predominating lesion in the positive and probable cases, constituting 81.6 per cent of the former and 80.5 per cent of the latter.

12. In the positive cases the lesser curvature is the most frequent site of the ulcer or ulcers, the pylorus leading in the probable cases and in a combination of the positive and probable cases.

13. In tuberculosis of other organs associated with gastric tuberculosis, the lungs take the lead, closely followed by the intestines.

14. No case of tuberculosis of the stomach has been absolutely proved to be primary in the stomach.

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STENOSIS OF GASTRO-ENTEROSTOMY STOMA, SIMULATING RECURRENCE OF CARCINOMA OF THE STOMACH

Report of Two Cases[1]

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RADICAL cures following resection of the stomach for carcinoma are by no means very frequent. Many cases begin to complain about recurrence of their pre-operative symptoms (vomiting, loss of weight, etc.) in a comparatively short time after the original operation. Therefore we are apt to suspect a recurrence of the carcinoma in these cases and consequently advise against any further operative interference. And yet not all cases of this group are really suffering from a recurrence of the original tumor. The following two cases are presented as evidence that all the classical symptoms of recurrence of cancer of the stomach can be simulated by mechanical causes not due to recurrence or metastasis of the original tumor.

Case 1. L. S., age 36; admitted August 18, 1915; discharged September 21, 1915. Diagnosis, carcinoma of the stomach.

History. The patient has lost about 20 pounds in the last six months, otherwise she claims to have been perfectly well up to a week ago. In the last week she vomited a great deal and complained of weakness and pains in the epigastrium.

Examination showed a large nodular mass, extending across the epigastrium, slightly movable. It was thought possible that this mass might represent a tumor of the transverse colon. A barium enema given to this patient on August 21, 1915, showed a defect in the middle transverse colon. By request of the X-ray Department, another barium enema was given, and this second enema failed to reveal any defect in the transverse colon. This defect then only represented a spastic condition of the transverse colon. The X-ray examination of the stomach showed a defect in the pyloric region, affecting the greater curvature and adjacent portion of the stomach; the passage through the pylorus was obstructed. Six hours after injection, a large residue was present. Diagnosis: Neoplasm of the pyloric end of the stomach.

Test meals showed a large residue; no free acid; total acidity 18; no blood.

The patient was in such a weak condition that a blood transfusion was deemed advisable before operation. There were given 400 cubic centimeters of blood, with the Kush apparatus.

Operation, August 28. Partial gastrectomy, button gastrojejunostomy for carcinoma of the pyloric end of the stomach (Dr. Lewisohn). The abdomen was opened through an upper median incision. A large tumor involving the pyloric end of the stomach was found. The tumor was freely movable. No metastases were found. Typical resection of the stomach after the second Billroth method. Posterior retrocolic button gastrojejunostomy. Specimen: The tumor of the pylorus is the size of an orange; the mucosa is ulcerated, surrounded by raised margins. There is a sufficient part of normal stomach and duodenum on both sides of the specimen. Microscopical diagnosis: adenocarcinoma.

Recovery uneventful; patient left the hospital on September 21, 1915.

Patient re-admitted to the hospital on January 17, 1916; discharged February 19, 1916. An X-ray examination taken a few days before re-admission showed that the Murphy button was still in place. Considerable gastrectasis and marked delay in the emptying of the stomach. The patient has been perfectly well for two months following the primary operation. In the last two months she is complaining of incessant vomiting, marked weakness, and loss of weight. She has lost 70 pounds since the onset of her symptoms.

January 22, 1916: Operation for inefficiency of gastro-enterostomy stoma (Dr. Lewisohn). The abdomen was opened through an upper median incision. The exploration revealed the button at the site of the anastomosis. The button had not turned around on its axis, but was still in exactly the same position where it had been put at the previous operation. The lumen of the button was still connecting the stomach with the jejunum. One hard gland in the gastrocolic omentum was removed for diagnosis, otherwise there were no signs of any recurrence of the carcinomatous growth. A moderate pressure was exerted to force the button through into the jejunum. This was not feasible. Therefore, the gastro-enterostomy was reopened, the button removed, and a suture gastro-enterostomy was done at the site of the previous stoma. The wound was closed with through-and-through chromic sutures and an additional silk suture for the skin. Microscopical examination of the lymph node showed a metastatic adenocarcinoma with extensive calcification.

The patient made an uneventful recovery, except for a rather profuse diarrhœa, following the second operation.

Postoperative course. This patient has gained about 70 pounds since the operation. She looks

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and feels perfectly well. There are no signs of any recurrence at the present time (August 1917). Weight 155 pounds.

CASE 2. M. A., age 35; admitted November 29, 1915; discharged December 30, 1915. Diagnosis: carcinoma of the stomach.

History. The patient had been suffering from burning sensation in her stomach for two months; no vomiting. She has lost 25 pounds in weight in the last year and complains of progressive weakness.

Examination showed a peculiar nodular mass, somewhat tender, in the epigastrium.

The test meals showed a trace of blood, lactic acid positive, free acid 6, total acidity 40.

The X-ray examination showed a defect in the lesser curvature and a slight delay in the motility of the stomach. Diagnosis: carcinoma of the stomach.

Operation, December 1, 1915. Partial gastrectomy and retrocolic gastro-enterostomy for carcinoma of the stomach (Dr. A. A. Berg). The exploration showed a hard infiltrating mass, the size of a large orange, obviously a carcinoma, which was found to involve a large part of the stomach, chiefly at the lesser curvature. Several enlarged glands were found in the mesocolon. A typical resection of the stomach was performed following the second Billroth method. Upon examining the specimen, it was found necessary to remove another inch of the stomach wall, as the previous incision had been made too close to the tumor. After the stomach and duodenal end had been closed in the typical way, a posterior retrocolic button gastrojejunostomy was performed and the abdomen was closed with through-and-through sutures. The specimen showed a hard circular ulcerating carcinoma, involving chiefly the lesser curvature, size 4 x 4 inches. The microscopical examination showed an adenocarcinoma with involvement of the lymph nodes. The small portion of the stomach subsequently removed does not show any cancerous growth.

The patient made an uneventful recovery and was discharged on December 30, 1915.

Patient re-admitted to the hospital, April 1, 1916; discharged May 11, 1916. The patient has suffered from pain in the epigastrium for the last two months. She has vomited repeatedly and has required lavages during the last three weeks. She is extremely emaciated. The X-ray examination shows a marked obstruction of the gastrojejunostomy opening, with retention of the bismuth meal in the stomach. Diagnosis: stenosis of gastro-enterostomy stoma.

Operation (Dr. Berg), April 5. The abdomen was opened along the line of old scar; the adhesions of omentum to abdominal wall were divided. A loop of jejunum about eighteen inches from the duodenum was tightly adherent to the abdomen. This adhesion was divided and the raw area of the jejunum was covered with peritoneum. There was no dilatation of the gut above this adhesion. The gastro-enterostomy was very small and very difficult to find. The stomach was adherent everywhere. The lesser sac was obliterated. An adhesion between the stomach and liver was divided. Because of the obliteration of the lesser sac, a Roux-Y shaped anastomosis was necessary. There were no apparent metastases or recurrences present. The jejunum was divided about 10 inches from the duodenum. The proximal end was united to the jejunum with end-to-side button anastomosis. The distal end was closed with an inverted layer of chromic and two pursestrings of Pagenstecher. An antecolic side-to-side suture gastrojejunostomy united the stomach and the distal end of the jejunum. After completion of the operation, the stoma easily admitted two fingers. The abdominal incision was then closed with through-and-through silk sutures.

The patient made an uneventful recovery with the exception of a rather marked diarrhœa, which lasted for a few weeks and yielded to treatment.

The patient left the hospital on May 11, 1916.

Postoperative course. This patient has done remarkably well since the second operation. When she left the hospital, she weighed 68 pounds. She has gained weight rapidly since, and on November 26, 1916, she weighed 131½ pounds. She looks perfectly well and has no symptoms of distress or vomiting. She is apparently in perfect health at the present time (August 1917).

The reason for reporting these two cases is the fact above mentioned, that the classical symptoms of a recurrence were simulated by a simple stenosis of the stoma. I have not been able to find a similar observation in the surgical literature. None of the textbooks on cancer of the stomach seems to consider the possibility of such an occurrence.

The cause of the stenosis is not quite evident. To be sure, the Murphy button was still in place in the first case at the time of the re-laparotomy. However, the button had not turned around on its axis and the lumen between the stomach and jejunum was unobstructed. It cannot readily be explained why the button which had remained in its original position should have caused obstruction.

In the second case, the button had passed two weeks after the original operation. It is generally assumed that gastro-enterostomy stomas, with the aid of a Murphy button, do not contract, especially when the pylorus is permanently closed by resection, and yet this opening 4 months after the primary operation hardly admitted a lead pencil.

Only a careful study of these cases, greatly aided by the X-ray department, prevented us from labeling the cases as inoperable, recurrent cancers. Without the second operation these patients certainly would have died in a short time from inanition; the possibility of a stenosis of the gastro-enterostomy stoma, simulating recurrence of the cancerous growth, should certainly be considered in all cases of this group. A small percentage might thus be saved by a comparatively simple operation.

STERILIZATION AND CLOSURE OF SUPPURATING FRACTURES

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DURING the past year, it has been shown in this hospital that recent fractures can be sterilized and closed (1). It was important to ascertain whether the same method could be applied to older cases in hospitals removed from the battlefield, and for this purpose old and highly infected fractures were removed from the trains bound for Paris at a station situated close to our hospital. The patients reached the hospital a few hours earlier than they would have reached the Paris hospitals. But this anticipation of a few hours was negligible, since 2 to 46 days and even 8 months had elapsed since the injury.

A great many fractures of the long bones remain fistulous. Probably 50 per cent of fractures of the thigh still suppurate after ten months' treatment. This estimate of the number of osseous lesions which remain fistulous after long deferred treatment may appear excessive to surgeons primarily concerned with industrial traumatisms. But unfortunately in the actual conditions of war surgery, i. e., fractures of the long bones produced by bursting shells, our estimate falls short of the reality.

After four months of experimentation devoted to regulating the details of this special application of Carrel's method, we are in a position to affirm that fractures in full process of suppuration can be sterilized and closed. The technique comprises the following points: (*a*) preliminary disinfection, (*b*) operative treatment, (*c*) sterilization, and (*d*) closing of the focus of fracture.

PRELIMINARY DISINFECTION

In nearly all instances the patients had received surgical treatment a few hours after injury in a hospital near the front. At first sight this treatment appears either complete or incomplete. In some cases we are confronted with a widely exposed fracture; in others with a badly cleansed cavity which communicates with the exterior only by means of one or more inadequate openings. In the latter case one is tempted to perform an immediate operation, and this procedure has often been followed in the base hospitals. But this should be absolutely prohibited, for an operation conducted under these conditions is followed by a marked rise in temperature, and sometimes by septicæmia and death.

Before an operation is attempted, infection must be reduced as much as possible. This is accomplished by discontinuous flushing with Dakin's solution. If it is impossible to introduce tubes into the focus, careful incisions may be resorted to, but the bones should not be handled. These incisions do not expose the patient to the grave complications which ordinarily follow osseous operations performed in an infected focus. This preliminary disinfection must be done in all cases, whether the previous operation has been well or badly conducted. An exception may be made in the case of very old fistulous fractures which show no inflammatory reaction.

The first process must be carried out by an exact observance of the principles of Carrel's method (2) and of the details of its applica-

tion. The progress of disinfection should be followed on the bacteriological curve, for it is imperative that one should be able to visualize at a glance the modifications in the number of bacteria. Every other day, after the flushing has been suspended for two hours, films are made of secretions from the wound taken from such parts as are apparently most highly infected. The bacteria of three microscopic fields are counted on this preparation and the average result of the observations is registered on the curve. The curves thus obtained are different from the sterilization curves of fresh fractures. The latter, at the outset, show no or very few bacteria in films of their secretions, and the bacteria appear in large quantities only after twenty-four or thirty-six hours. They increase in number for some time, after which a rapid and regular diminution occurs. This is illustrated by the following experiment.

CASE 1. Recent, comminuted bullet fracture of the femur. Immediate removal of the splinter of bone; rapid sterilization. Suture with horsehair on the fourteenth day.

G. M., age 42; wounded July 1, 1916, at 11:30 p.m.; entered Hospital 21 six hours later.

Examination. Small opening in the center of the antero-external region of the left thigh. No outlet. Abnormal mobility due to a fracture of the center of the femoral diaphysis. Moderate inflammation. The roentgenogram shows a highly splintered fracture, with a bullet in the center (Fig. 1).

Operation. Ether anæsthesia; resection of the edges of the cutaneous and aponeurotic openings. Wide incision; ablation of a small number of free splinters; preservation of several adherent splinters.

Flushing every two hours with Dakin's solution by means of four tubes. Continuous extension.

As is usual in recent wounds, the first examination failed to reveal any bacteria (Fig. 3). Two days later one bacterium was found in every ten microscopic fields. The maximum (twenty bacteria per field) was reached on the ninth day. On the thirteenth day the wound was sterile. On the fourteenth day the wound was sutured with horsehair and without drainage.

The two roentgenograms taken at the beginning and end of the treatment (Figs. 1 and 2, respectfully) show to what extent it was possible to reduce the fracture after its reunion.

The bacteriological curves observed in the case of old fractures are usually very different from the one we have just examined. In these cases, the beginning of the curve indicates the presence of an infinite number of bacteria, except where a dry scab makes it impossible to obtain a film of the secretions. On the other hand, the diminution in the number of bacteria takes place more slowly than in the case of recent fractures, and is accompanied by oscillations which may last for some time, as in the following case.

CASE 2. Old infected shell fractures of the sacrum. Slow preliminary disinfection. Hollowing out of the site of fracture. Sterilization. Closing of wound over an adipose graft.

P. B., age 34; wounded September 17, 1916. Operation by incision and extraction of splinters in a front-line ambulance thirty hours later. Entered Hospital 21 October 5, eighteen days after being wounded.

Examination. In the sacral region was a large horizontal, anfractuous wound, 12 by 6 centimeters, communicating (*a*) by means of a submuscular sinus with a small wound in the left buttock, and (*b*) with the sacral fracture. The entire visible portion of the wound was covered with a dry scab produced by the local application of phenol. Lymphangitis. Temperature 37.6° C. General condition satisfactory. Films showed twenty to forty bacteria per field.

Preliminary disinfection by flushing every two hours with Dakin's solution was immediately started. The curve (Fig. 4) shows that the films made from the dry scab of the wound contained only a small number of bacteria. Not until the third day did the bacteria become innumerable. After a period of oscillation, the curve appeared from October 21 to 29 to tend toward sterilization. But this was followed by a series of fluctuations of five to twenty bacteria, showing the presence in the wound of foreign septic bodies (sequestra, fragments of clothing, etc.). Under these conditions intervention became necessary.

November 12, incision of the sinus. Opening of the site of osteitis, which was seen to contain six small sequestra and to communicate with the sacral canal. All the suspected osseous tissue was resected with the gouge-forceps (*pince-gouge*). Beneath the left sacrolumbar muscles muscular detachment was found. This was opened and the wall excised. All the visible necrotic tissue was carefully removed from the wound (Fig. 5).

Sterilization by means of flushing was next resumed. The day after the operation, the temperature rose to 39° C. and the number of bacteria increased. The temperature fell rapidly, and on November 18, six days after the operation, the wound was sterile.

For several days a pulmonary complication made it impossible to close the wound. Finally, on December 15, after a short reinfection followed by a return to the sterile condition, the wound was filled up by means of an autoplasty (Fig. 6), after an

adipose graft in the focus of the fracture of the sacrum had been effected. The graft was taken from the left buttock.

On the sixth day, as a result of traction of the flaps, three of the stitches were cut. The adipose graft in the wound was living and was rapidly becoming covered with fine granulations and later with epidermis.

This observation of a highly infected fracture of the sacrum, the sterilization of which proceeded exceptionally slowly, gives an exact idea of the method followed. It will be seen that the preliminary disinfection was patiently pursued for as long a time as the bacteriological curve continued to decline. As soon as a plateau appeared in the chart curve, surgical intervention was seen to be necessary. When this had been performed, the course of sterilization continued in a normal manner.

We have said that it was not always necessary to have recourse to surgical intervention in order to secure the sterilization of an old fracture. This is explained by the fact that the operation performed at a first-line ambulance may have been sufficient. Case 3 is an example of this type.

CASE 3. Infected fracture of the thigh, nine days old. Sterilization attained on the twelfth day. Closure on the seventeenth day, without operation.

L. J., age 25; wounded October 11, 1916; operated upon the following day in an ambulance on the Somme. October 20, entered Hospital 21.

Examination. Fracture of the middle of the left thigh bone. Two wide wounds led to the site of fracture. Their long axis was longitudinal. The outer wound measured 12 by 6 centimeters; the inner had similar dimensions (Fig. 7). Abundant suppuration; pyocyanic. Extensive inflammation of the limb. Patient looked tired. Films showed forty to sixty bacteria per field.

Figure 9 shows a splintered fracture with fissures which descended very far down and extended almost to the top of the limb. Extensive loss of substance over an area of 8 centimeters. However, as the fragments came in contact with one another, the continuity of the osseous layer was uninterrupted.

Flushing every two hours with Dakin's solution. Exploration conducted at the time that the tubes were inserted showed that the upper end of the fracture was exposed and that a medullary plug was already covering the lower extremity. The roentgenogram showed that only the upper part of the fracture was being flushed. As a matter of fact, the disposal of the tubes was good, for sterilization was obtained in twelve days (Fig. 10), and on the seventeenth day the fracture was closed.

Closure on November 6. Both wounds were closed; the inner one was sewed with horsehair in one single cutaneous plane; the outer in two planes over a filling of Beck's paste. Of these two planes, the first, or musculo-aponeurotic plane, was sewed with catgut; the second, or cutaneous plane, with horse-hair (Fig. 8).

OPERATIVE TREATMENT IN THE FOCUS OF THE FRACTURE

It must be assumed at the outset that the appearance of a plateau in the bacteriological disinfection curve is an indication of the presence in the wound of infected foreign bodies. These may be necrotic fragments of tendon, aponeurosis or bone, projectiles, particles of clothing, etc. Of whatever nature, it is imperative that the foreign body should be removed.

When surgical treatment is applied to flat bones or epiphyses of long bones, it presents no particular difficulty. With the help of a gouge-forceps or a *fraise* all the compact or spongy tissue affected with osteitis or preventing extensive flushing is carefully abraded. It is necessary, as far as possible, to avoid opening the joints which are capable of movement, without losing sight of the fact that any part which is well exposed and thoroughly flushed will never become dangerously infected.

The surgical treatment of old fractures of the long bones, on the other hand, presents real technical difficulties. It does not suffice to remove the sequestra, or to abrade the necrotic surfaces, or even to curette all the foci of osteitis. This form of surgery, which has been practiced on thousands of cases since the beginning of the war, has usually resulted in failures. As a rule, when this method has been used, infection sets in rapidly in the bone marrow and in the clots of blood remaining in the wound. Osteomyelitis and lamellar necrosis of the walls of the medullary canal are the ordinary consequences of this kind of surgery, while opening of intra-osseous abscesses produces fresh fistulæ.

In order to avoid these complications, it is necessary to perform a systematic operation involving the successive consideration of the following factors: incision, periosteal callus, sequestra, splinters, and bone ends.

Incision. In preparing the patient, tincture of iodine should not be employed. Dakin's solution, which is necessary for the further sterilization of the wound, generally produces burns on an iodized surface.

The incision need not necessarily extend beyond the fistula or the wound of the first operation. Exposure of each diaphysis is made according to definite rules, by which a maximum portion of the bone may be exposed with a minimum of risk to the adjacent organs. The operation should be conducted plane by plane, by successively detaching and utilizing each in such a manner that the hæmostasis may be facilitated and the wound as a whole may contract from the surface inward. If the line followed is that of a fistula or of an infected wound, it is preferable to excise all the infected and sclerous tissues, and the process of elimination or sterilization will thereby be reduced. But it is important to keep account of the quantity of tissue disposed of, and care must be taken that sufficient skin is kept for future closing. The consideration of this fact has often prevented us from excising the edges of the mouth of a fistula.

Osteitis of the periosteal callus. The best method of penetrating the periosteal callus, after the surrounding osteogenic membrane has been turned back, is effected by careful manipulation of the rugine. With the help of roentgenograms, this uncovering must be confined to that part of the callus which is to be excised. Through the opening thus made, a gouge-forceps is introduced, which extends the infected cavity of the periosteal callus in the direction of the bone ends which are to be explored. The extremities of the fragments must be exposed. In order to reach the end of the callus, it will suffice to scoop out with a curette every part affected with osteitis.

If the fracture is recent, or if the periosteum has suffered extensive destruction, there is no callus. In such cases the fracture cavity can be immediately penetrated, and the bone ends are consequently more easily accessible.

Sequestra. These may be found in the muscles, focus of fracture, and medullary canal. If present in the muscles they are easily removed by an incision; but they are harder to find if situated on the side opposite from which the incision is made. In such cases, after making a good roentgenogram, they are best reached by means of a special incision. A careful investigation should be made for sequestra which may have been projected into the medullary canals at the time of injury. Their presence constitutes one of the causes for the absence of the medullary plug observed in the course of the consolidation of fractures.

Splinters. If the splinters are necrotic, all fragments which are not indispensable to consolidation must be removed.

Bone ends. These are sometimes exposed at the site of fracture, and sometimes obliterated by an osseous plug. The sealing of the fragments by the medulla must be considered as a normal stage in the evolution of open fractures. This process is impeded in various ways. Sometimes, as we have seen, the projection of a fragment of bone, which rapidly becomes necrosed, may be the cause; in other cases the plug, after formation, has been destroyed by osteitis. But in the majority of cases the defect of obturation is explained by an intense infection, which has from the outset produced necrosis of the contents of the medullary canal and of its walls. In such cases the bone ends are laid bare and are seen to be exposed and bathed in the pus proceeding from the site of fracture.

All severe accidents that follow upon operation in the focus of infected fractures are invariably connected with the opening of the medullary canal. The operation sets free the bacteria and provides them with contused tissues and clots of blood favorable to their cultivation, with the result that if in their vicinity there is an inadequately drained canal filled with an easily infectible marrow, the immediate result will be the occurrence of severe septic accidents.

We have regularly observed the following phenomena: (*a*) A fracture in which the bone ends are obturated causes no postoperative reaction. (*b*) A fracture in which the bone ends are not occluded produces an intense reaction, if the cavity of the medullary canal is not plentifully flushed by the antiseptic solution. (*c*) A fracture in which the non-occluded bone ends have been widely opened

Fig. 1 (at left). Roentgenogram, Case 1, showing fracture of left femur, with bullet in the center.

Fig. 2. Roentgenogram taken at the end of treatment in Case 1.

by surgical intervention will produce no reaction.

From the above facts we have drawn the following conclusions for the treatment of bone ends: (1) The surface of the medullary plugs should be explored with a curette, in order to ascertain that there is no communication with the subjacent medullary canal and that no sequestrum is enclosed. (2) The medullary canals which have remained open should be hollowed out with a *pince-gouge* in such a form as to produce a wedge-shaped cavity, communicating freely with the flushing tubes.

As an illustration, we shall report two cases of fracture of the humerus, one of which was characterized by two obturated medullary canals, and the other by the fact that the bone ends remained opened.

Case 4. Infected shell fracture of the upper third of the humerus. Double medullary plug.

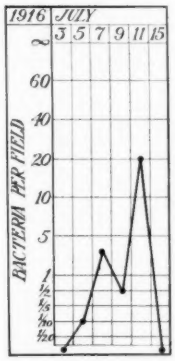

Fig. 3. Bacteriological curve of films from the wound in Case 1.

Operative treatment without resulting reaction. Closure of wound.

V. M., age 21 years. Wounded October 21, 1916. Operated on the following day in a first-line ambulance; entered Hospital 21 November 6, seventeen days after sustaining the injury.

Examination. Comminuted fracture of the surgical neck of the left humerus (Fig. 11). Three wounds: anterior, posterior, and external (Fig. 12).

Two drains crossed the site of fracture from front to back. Abundant suppuration; slight œdema of the member. General condition good. Films showed an innumerable number of bacteria in the anterior wound, and about thirty per field in the posterior wound.

Discontinuous flushing with Dakin's solution. The number of bacteria diminished in both wounds, but the curve soon indicated a plateau, at the degree of infection of twenty bacteria per field (Fig. 14).

Operation. December 2. Anterior incision made in the wound. Removal of a sequestrum situated above, two sequestra situated laterally, and the necrotic end of the lower fragment. The two bone ends were obturated by a medullary plug (Fig. 15).

Temperature 37.9° C. on the evening of the second day. Rapid decline in the number of bacteria, and sterilization effected twelve days later. Suture with horsehair on December 21 (Fig. 13).

Case 5. Infected shell fracture of the upper third of the humerus. Absence of medullary plug at the site of the upper fragment. Operation followed by an inflammatory reaction. Closure of wound.

C. D., age 28; wounded October 11; operated on the same day in a first-line ambulance. Entered Hospital 21 October 20, nine days after receiving injury.

Examination. Punctured wound in the anterior region of the left axilla. At the level of the upper third of the arm there was a vertical posterior wound, measuring 8 by 6 centimeters (Fig. 16). The surface of this wound was covered with necrotic

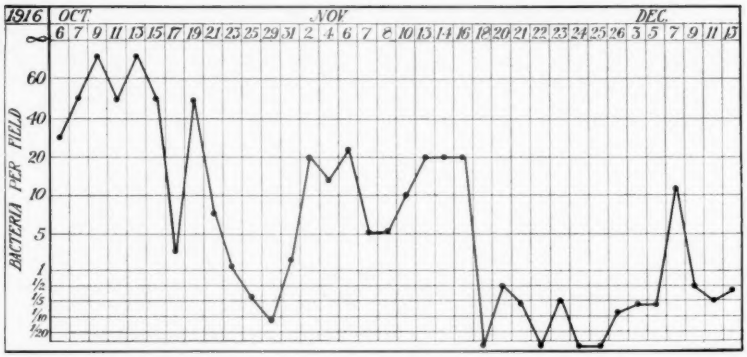

Fig. 4. Bacteriological curve of films from the scab of the wound in Case 2.

tissue. The wound led into a focus of splintered bones occupying the lower part of the surgical neck of the humerus (Fig. 18). Œdema. General condition good. Temperature 38° C. Films taken of the posterior wound showed ten bacteria per field. Flushing every two hours with Dakin's solution.

On November 5, after some fluctuation (Fig. 19), the number of bacteria had diminished to less than one in twenty fields. But as cicatrization had been very rapid, the wound had become narrow and it was impossible to flush it out. The bacteria immediately increased in number until they reached forty to sixty per field. It was evident that under these conditions, the fracture could not be sterilized without surgical operation.

Operation. On November 11, excision *en masse* of the fistula. This led to a small opening at the back of the periosteal callus. The callus was opened with chisel and hammer. The gouge-forceps was enlarged in such a manner as to expose the bone ends. The callus contained three small longitudinal sequestra. The medullary canal of the upper end of the bone remained open. Its edge was abraded sufficiently to permit flushing. The extremity of the lower fragment was obturated by a medullary plug, but the edge of the bone was necrosed for a distance of several millimeters. This bone was removed with the gouge-forceps.

The operation was succeeded by a fairly strong inflammatory reaction, and the following day the temperature rose to 38.9° C. But the normal condition was speedily restored, and when the temperature fell, films taken on November 15 showed that the number of bacteria had already been reduced to eight per field.

Closure. On December 3 the focus was sterilized. On the 7th it was closed over a chloramine and sodium stearate paste filling, by means of two planes of suture, one musculo-aponeurotic, the other cutaneous (Fig. 17).

Fig. 5. Sacrolumbar wound in Case 2.

Fig. 6. The wound was filled with an autoplasty after an adipose graft in the sacrum.

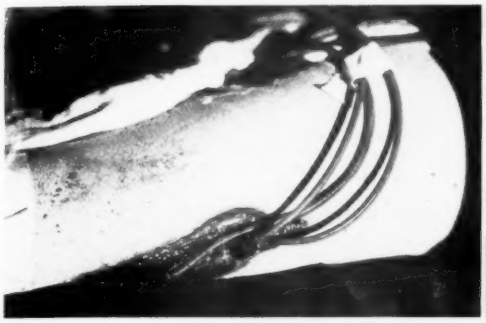

Fig. 7. Wound of the thigh, Case 3.

Fig. 8. The same as Fig. 7, closed with horsehair.

STERILIZATION OF THE FOCUS OF FRACTURE

In infected fractures of the long bones, the wide opening of the non-obturated medullary canal is a factor of importance. But this detail in itself does not suffice to prevent every form of reaction. It is usually observed that the temperature reaches its maximum in the evening of the second day after the operation. Thus, there is an interval of more than twenty-four hours during which the multiplication of bacteria at the surface of the new wound should be prevented as much as possible.

It was found that in the first days of sterilization the most infected parts were always the blood clots situated in the vicinity of the severed bones or of the medullary cavities. Therefore, it was attempted to prevent the formation of the clots. With this object in view, after having clamped and ligated all the bleeding vessels with the utmost care, we arrested all oozing of blood from the bones and medulla, by means of prolonged flushing with physiological salt solution at 40° C. Sometimes more than a quarter of an hour was needed to obtain this result, but there is no doubt but that this perfecting of the technique has

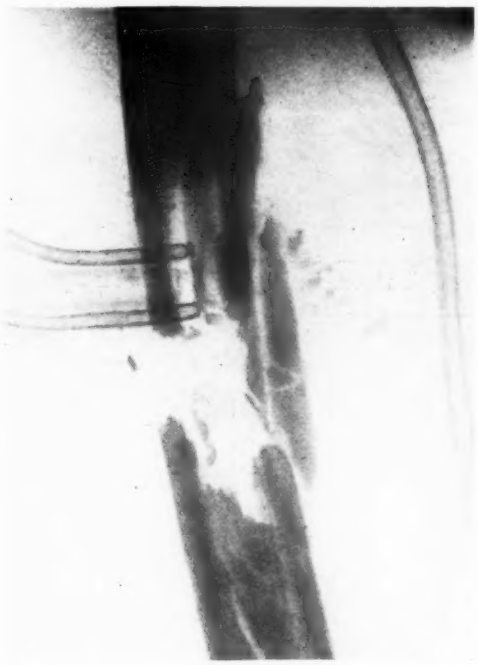

Fig. 9. Roentgenogram Case 3, showing fracture of left femur with deep fissures.

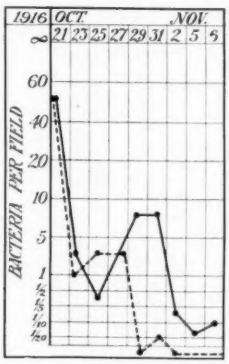

Fig. 10. Bacteriological curve of films from wounds, Case 3. ———— External wound; ..... internal.

Fig. 11. Roentgenogram Case 4 showing comminuted fracture of the surgical neck of the left humerus.

Fig. 12 (at left). Anterior, posterior, and external wounds, Case 4.
Fig. 13. Wounds sutured with horsehair.

shortened the time employed in the process of sterilization.

In a similar manner the process of disinfection during the first two days was accelerated by flushing out the wound every half hour during the day and every hour during the night, after which the usual flushing every two hours was resumed.

When flushing is repeated at close intervals, it is important to use hypochlorite prepared electrolytically, as this substance exerts only slight irritation on the skin.

The combination of these three processes, the wide opening of the medullary canals, careful hæmostasis, and frequent flushing with electrolytic hypochlorite, has enabled us practically to suppress all postoperative febrile reactions.

This method of procedure has also greatly

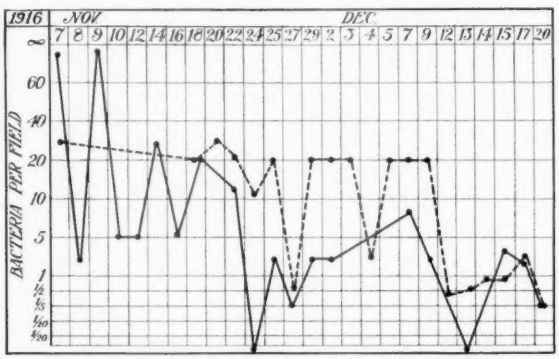

Fig. 14. Bacteriological curve of films from wounds in Case 4. ——— Anterior wound; - - - - - - - - - -, posterior wound.

Fig. 15. Combination roentgenogram and drawing of Case 4. The roentgenogram was taken after removal of sequestra and necrosed end of lower fragment of the bone; the drawing showing the operation performed. *M. P.* Medullary plug; *S*, sequestra.

affected the course of the bacteriological curve. After our first operations on old

Fig. 18. Combination roentgenogram and drawing, Case 5, showing fracture of the humerus and operation performed. *M. P.*, Medullary plug; *S*, sequestra.

fractures, the number of bacteria increased *ad infinitum* during the next few days. It will be seen by means of the accompanying charts that this bacterial increase has now become almost negligible. At all events, after a varying length of time, the number of

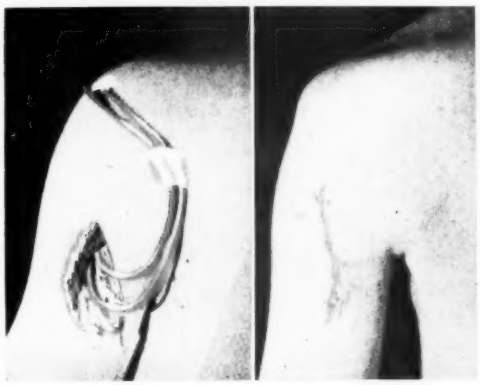

Fig. 16 (at left). Case 5. Wound of upper third of arm and in axillary region.
Fig. 17. Wound sutured.

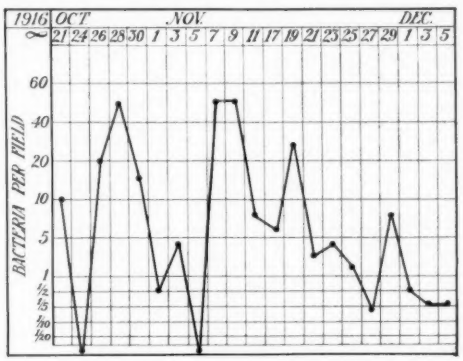

Fig. 19. Bacteriological curve from films of the wound in Case 5.

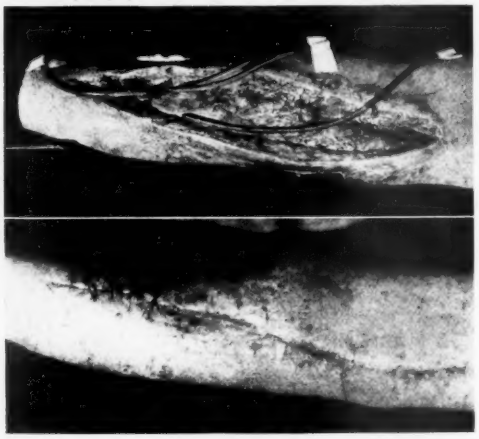

Fig. 20 (at top). Wound of the inner surface of right leg and thigh, Case 6.
Fig. 21. Wound sutured over an adipose graft.

bacteria falls below three per field. When this stage is reached, it is advisable to let several days elapse before closing the wound.

CLOSURE OF THE WOUND

In fresh fractures, once sterilization is assured, the closing of the cavity is effected without any special difficulty. After resection of the edge of the epidermis, the edges of the wound are dissected. Profuse bleeding is avoided as much as possible. Horsehair sutures are performed. If pressure is applied to the dressing, while at the same time the bone ends and adherent splinters are

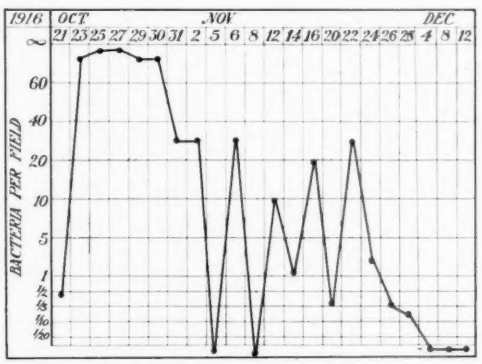

Fig. 23. Bacteriological curve of films from Case 6.

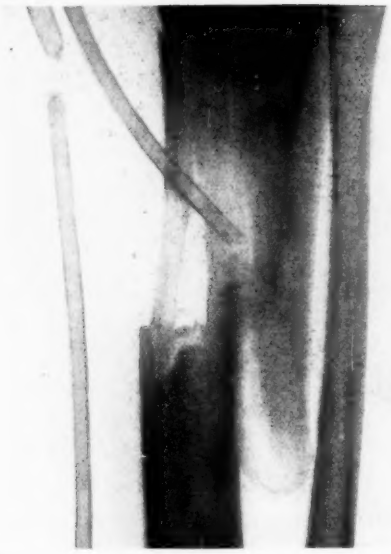

Fig. 22. Roentgenogram showing fracture of right tibia.

brought together, the cavity produced by the fracture will be completely obliterated.

The same procedure is also successful in old fractures if the periosteal callus is not in process of formation, or if the condition of the muscles makes it easy to force them back into the cavity.

In all other cases the focus of fracture cannot be closed without the aid of a filling, for otherwise a cavity would be left beneath the sutures, in which the secretions of the wounds would accumulate. Various kinds of filling were experimented with: Mosetig's substance, Beck's paste (Case 3), chloramine paste (Case 5), and adipose grafts (Case 2).

The results can be summed up in the following statements: Beck's paste is superior to that of Mosetig, for it is easier to apply and involves no danger of intoxication. Beck's paste, used under conditions with which we deal, necessitates the interposition of a musculo-aponeurotic plane between the paste and the cutaneous sutures. In the case of old fractures it is hard to effect this interposition. The chloramine paste has the advantage that it can be applied directly beneath cutaneous sutures. But it falls away if, as

Fig. 24. Roentgenogram showing transverse fracture of tibia and fibula. Case 7.

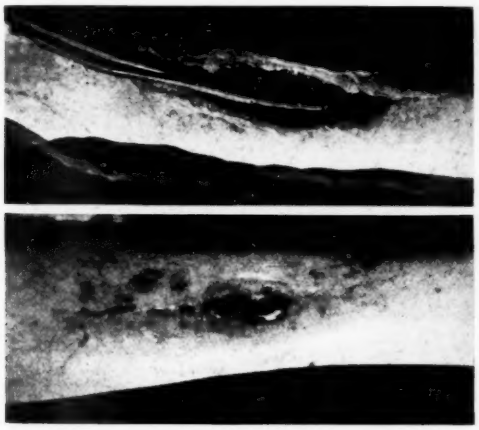

Fig. 25 (at top). Wound of leg, Case 7.
Fig. 26. Wound closed.

frequently occurs in the case of old fractures, the sutures pull and gap slightly, owing to the lack of tissue. The best filling seems to be an adipose graft; but this procedure must be limited to cases in which the formation of the periosteal callus is well advanced and where there is no danger of pseudarthrosis. With this one limitation, this method is found suitable in the majority of cases, since (1) it does not require the making of a musculo-aponeurotic layer; (2) the graft is always obtainable in the vicinity of the zone of operation; and (3) it will keep in place even in cases where, owing to the lack of a sufficient quantity of cutaneous tissue, the wound has remained partially open.

CASE 6. Old infected shell fracture of the tibia. Sterilization of the focus. Wound closed over an adipose graft.

J. V., age 31; wounded October 10, 1916; operated on fifty-one hours later in an ambulance on the Somme; entered Hospital 21 October 20, ten days after being injured.

Examination. The inner surface of the leg and of the right thigh showed a large muscular wound, of about 50 square centimeters in area (Fig. 20). At the lower third of the wound there was extensive loss of tibial tissue (Fig. 22). The muscles were covered with necrotic tissue. The focus of fracture contained a serous fluid, as well as the broken ends of the bone, which constituted an irregular cavity. Innumerable bacteria were seen on the films. On the first day the films were obtained from a part of the surface of the wound covered with a dry scab, and contained but a few organisms.

On October 27, one week after the patient's arrival, the wound was cleansed. On October 30 the number of bacteria began to diminish (Fig. 23), but from November 2 to 22 it fluctuated in the neighborhood of twenty per field. After November 22 the wound rapidly became sterile. Closure on November 30 with horsehair, but the cutaneous tissues were taut and were not present in sufficient quantities around the fracture. The cavity was filled with chloramine paste and every other day sufficient paste was added to maintain the sterility of the cavity. On December 13 the tissues appeared to have become sufficiently supple again to permit of their being reunited. The site of fracture was filled with an adipose graft and the tissues were completely sutured (Fig. 21).

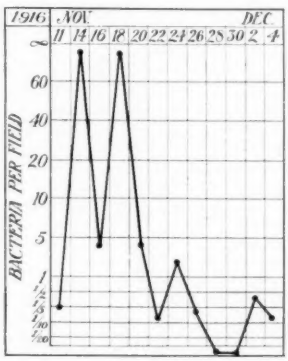

Fig. 27. Bacteriological curve of films in Case 7.

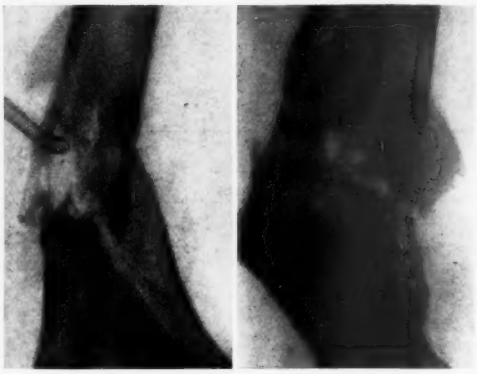

Fig. 28. (at left). Case 8. Roentgenogram showing fracture of femur.
Fig. 29. Case 8. Roentgenogram showing fracture of femur.

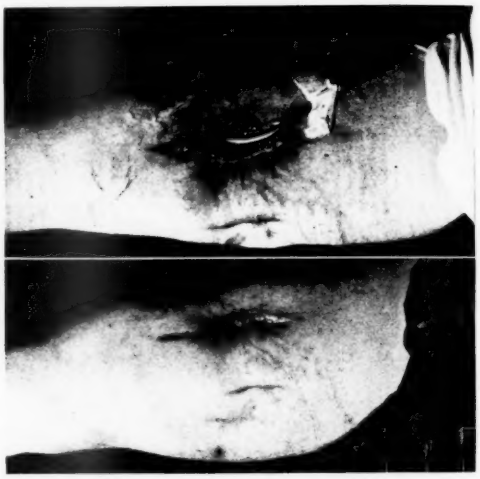

Fig. 31. (at top). Case 8. Antero-internal wound of thigh.
Fig. 32. Case 8. Postero-external wound of thigh, closed.

In order that the technique of applying adipose grafts may be successfully accomplished, a few special precautions should be observed.

The liberation of the edges of the cicatrix must be followed by careful hæmostasis. At this stage the horsehair stitches to be used for the suture are inserted. The center of these threads is placed along the ends of the wound, in such a manner that the graft can be slipped into the cavity of the fracture without catching in them. The graft tissue is then removed from the subject himself (after both gloves and instruments have been changed), either from the buttock or the antero-external region of the thigh. The patient should not be turned in order to remove the graft, for this may involve faults of asepsis. Before sliding the grafts into the cavity, the periphery of the cutaneous opening should be carefully protected by means of compresses, in such a way that there is no danger of either the skin or horsehair being touched. Once the graft is in place the threads need only be drawn.

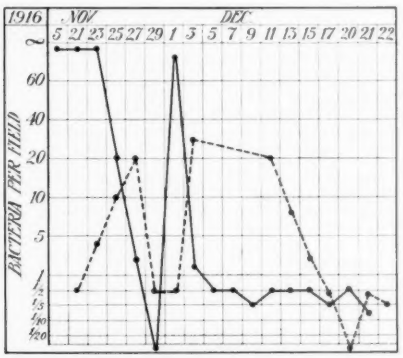

Fig. 30. Bacteriological curves from films in Case 8.

It has been seen in Case 6, how difficult it sometimes is to obtain a sufficient amount of skin to cover an old fracture. In certain cases failures result, and, after the wound has been closed as well as possible, the cavity must be allowed to fill up spontaneously. In such cases it is well to preserve its sterility by filling it up every day with chloramine paste.

The following is a good example of this difficulty.

Case 7. Open fracture of the leg, caused by a horse's hoof. Infection. Closure of the wound subsequent to operation and sterilization. Insufficiency of cutaneous tissue.

J. M., age 43; wounded August 17, 1916; operated upon in another hospital on August 18. October 8 entered Hospital 21, fifty-one days after being injured.

The first operation was an osteosynthesis, performed with a Lambotte plate which was removed 38 days after its insertion.

Examination. On the middle third of the leg, bordering on the lower third, there was a cicatrix measuring 20 centimeters in length by 0.5 centimeter in width, the lower part being detached by the distance of 5 centimeters. At this spot, the surface was inflamed and suppurating. Fracture non-consolidated and painful; the limb was œdematous. Films taken from the tissues, stained violet by an antiseptic, showed but few bacteria. The roentgenogram (Fig. 24) showed a transverse fracture of the tibia at the juncture of the middle and lower third. The fracture of the fibula was situated 2 centimeters higher. The fragments of the tibia were placed end-to-end. Several annulary sequestra, corresponding to the screws of the plate of Lambotte, could be distinctly seen in the bone ends. Disinfection with 10 per cent chloramine paste.

Rapid cicatrization, except at the level of three fistulæ leading to a portion of exposed bone. The narrowness of these fistulæ made it impossible to take the secretions for examination.

Operation. On November 13 the scar and the granulations were excised. The periosteum was ruginated at both ends of the bone, these being connected by means of fibrous tissue, whereupon the circular orifices corresponding to the roentgenogram were disclosed. Each of these openings was surrounded by a dark bony shell, which was cylindrical and mobile. These two bone ends were hollowed out, and the intermediary fibrous tissue was removed, and by this means a regular drainage canal was obtained, formed by the two bone segments.

Flushing every two hours with Dakin's solution (Fig. 25).

The following evening the temperature was 38° C. The bacteria, which on November 14 were infinite in number, rapidly diminished (Fig. 27). The focus was sterile on November 26. Closure on December 6. The skin although taken from remote parts, was unable to cover the middle portion of the wound. A section, 5 centimeters in length, at the site of the old fracture, remained open. The bone cavity was filled with chloramine paste. On each succeeding day after the operation the paste was renewed. Complete cicatrization twenty days after closing the wound (Fig. 26).

It is probable that in the case of very old fractures a considerable amount of difficulty would be encountered in covering the operated surfaces with healthy skin but our investigation has not yet been extended to this point, and was confined to a case eight months old at the time when surgical intervention was applied. In this case it was found possible to procure a sufficient quantity of autoplastic tissue for the purpose of covering the wound.

CASE 8. Infected shell fracture of the femur, eight months old. Operation. Sterilization. Closure of wound thirty-six days after operation.

J. A., age 26; wounded March 13, 1916; operated on in a first-line ambulance. Transferred to Hospital 21.

Examination. November 5. At the juncture of the middle and lower thirds of the right femur there was a large callus. The tissues showed two adherent scars, one antero-internal, the other postero-external. Each of these scars disclosed a fistula through which the denuded bone could be reached with the probe.

The roentgenograms (Figs. 28 and 29) showed a deviation of the axis of the bone. The ends of the bone were covered by periosteal callus. A side view showed that between the fragments there was a rarefaction of bone tissue corresponding to osteitis of the callus. In both the callus and the surrounding muscular parts small metallic fragments were discernible.

Both fistulæ contained a large number of bacteria (Fig. 30).

Operation. November 16. Vertical incision with excision of the walls of the antero-internal fistula. Liberation by means of the rugine of the inner side of the callus. The bony opening of the fistula was enlarged with the gouge and mallet. Next, a funnel-shaped opening was made in the callus by means of the gouge-forceps, until the zone of osteitis was reached, which in the side view of the roentgenogram appeared as a light spot. This procedure was repeated in the case of the postero-external fistula, and by this means one single and regular bone cavity was formed, terminating in healthy bone and opening widely to both sides of the thigh.

Flushing every two hours with Dakin's solution.

After December 3, the antero-internal wound (Fig. 31) rapidly became sterile. The postero-external wound was sterile on December 17.

Closure. On December 22, the postero-external wound had become linear in shape and closed up spontaneously (Fig. 32). The antero-internal wound was finally sutured with horsehair.

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SUCTION-BULB ACTION OF THE GALL-BLADDER

By AXEL WERELIUS, M.D., F.A.C.S., Chicago

UNTIL very recent times the gall-bladder was universally considered a biliary reservoir. The relative disproportion between the quantity of bile secreted, and the capacity of the gall-bladder, however, made such a theory untenable.

F. Rost[1] in a paper on experimental work on the gall-bladder, enumerates the various theories advanced in regard to the function of the organ in question. Sylvius held the view that the bile production took place within the gall-bladder. Orlab disproved this theory by performing cholecystectomy on dogs, demonstrating that after removal of the gall-bladder the bile still flowed into the duodenum.

Billard and Cavallie believed that the tenacious bile of the gall-bladder in mixing with the thinner gall from the liver somewhat retarded the bile current. Kalk considered the gall-bladder mainly as a mucin-producing organ. W. J. Mayo[2] advanced the theory that it took the pressure off the common duct, as evidenced by the dilatation of this tube following cholecystectomy.

In operating on a gall-bladder case some time ago, I noticed that the liver in its respiratory excursions produced a mechanical passive contraction and relaxation of the gall-bladder. I noticed alternately a collapse of the fundus and a distention of the indented area, corresponding to the respiratory movement of the liver.

This, of course, indicated that the intracystic pressure varied in inspiration and expiration. That such was the case was easily proved by the introduction of a tube into the gall-bladder of a dog, connecting it with a mercurial manometer. The accompanying charts show the variations in pressure, corresponding in time to the respiration. These alternating changes in the pressure take place in the closed as well as in the widely opened abdomen. In order to register these pressure changes under as normal intra-abdominal conditions as possible, the tube from the gall-bladder can be carried through the rectum and anus and then attached to the recording apparatus. The abdomen is then completely closed.

This contraction and relaxation of the gall-bladder, which undoubtedly is passive, takes place only at certain intervals. The gall-bladder, as observed in the open abdomen, appears to be mostly of fixed dimensions. This is explained by the fact that only at certain periods is the bile ejected into the duodenum. At other times the sphincter or valve, at the entrance of the duct into the bowel, is closed, damming back the bile into the gall-bladder. Not until this reflex obstruction is done away with will the massage of the liver cause this alternate passive contraction and relaxation of the gall-bladder and incidentally its suction action.

The gall-bladder and the liver-duct are arranged in exactly the same manner as a stomach tube with its bulb. Now as it is shown from the above that there takes place an alternate contraction and relaxation of the gall-bladder, it is reasonable to assume that the same physical phenomena occur in the bile-outlet as in the manipulated stomach tube. During inspiration there is, as shown by the above experiment, a decided increased pressure of the gall-bladder, and undoubtedly a pressure in the common duct is a great deal less than in the bladder. Thus the bile is forced into the duct. As the least resistance to the flow is in the direction of the duodenum (with open valve) the added impetus given by the emptying of the gall-bladder undoubtedly enhances the current in that direction.

During expiration the intracystic pressure is greatly lessened; in fact it is negative, and undoubtedly the pressure in the common duct is greater than in the bladder — consequently the bile flows into the sac.

[1] Rost, F. Die Funktionelle Bedentung der Gallen blase. Experimentalle. Anatomische. Untersuchungen nach Cholecystektomie. Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1913, xxvi, 710.

[2] Mayo, W. J. Collected Papers of the Mayo Clinic 1011, p. 140.

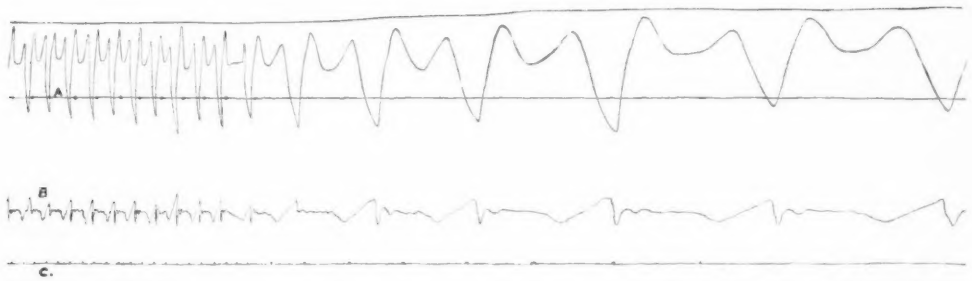

Fig. 1. *A*, Gall-bladder pressure changes — down stroke, inspiration; up stroke expiration. *B*, Respiration — up stroke, inspiration; down stroke, expiration. *C*, time in second intervals. At left of chart, slow drum: at right, fast drum. Dog weighed 23 pounds, 12 ounces. Ether anæsthesia.

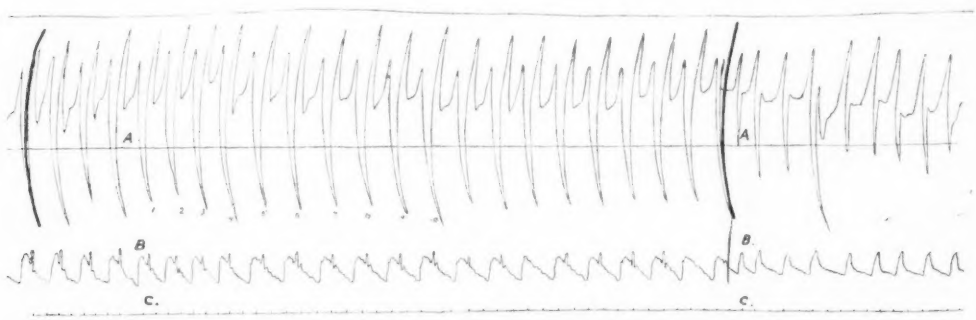

Fig. 2. *A*, Variations in gall-bladder pressure. At left of chart, abdomen closed, at right, abdomen open. Down stroke, inspiration; up stroke, expiration. *B*, Respiration — up stroke, inspiration; down stroke, expiration. *C*, Time, second intervals. Dog weighed 23 pounds, 12 ounces. Ether anæsthesia.

The rapid relaxation of the bladder probably produces a certain amount of suction; thus again enhancing the flow duodenumward.

With a proved alternate increase and decrease of pressure in the gall-bladder, and connected in the manner that it is to the bileduct, the gall-bladder must, by indisputable laws of physics act as an accelerator of the bile flow, when the duodenal valve is patent.

I wish to express my appreciation to Professor P. Dryer of the Department of Physiology of the University of Illinois, who, assisted by Dr. C. H. Phifer, made the above pressure tracings.

END-RESULTS OF NEPHRECTOMY FOR RENAL TUBERCULOSIS[1]

By WILLIAM E. LOWER, M.D., F.A.C.S., and THOMAS P. SHUPE, M.D., Cleveland, Ohio

THE lay public as well as members of the medical profession are no longer content with operative statistics which show only the mortality rate, for while a low mortality is always desirable, it is no less important to know whether or not the operation has cured the patient's disease, and also what postoperative complications, if any, have followed the operation. In other words, the success of any surgical procedure is to be determined by its *end-results* no less than by its attending mortality rate.

In discussing the end-results in the cases here considered, we must first determine how tuberculosis of the kidney is to be defined, for if the lesion is confined to the kidney, the cure is comparatively simple and positive; but if the ureter and the bladder are involved also, the problem and the results are vastly different.

Tuberculosis of the kidney without involvement of the ureter and bladder is comparatively rare, however, for in practically all cases that come to the surgeon the symptoms are referable to the bladder rather than to the kidney. For this reason, disappointment often comes to both the surgeon and the patient, because in those cases in which the bladder *symptoms* are secondary to grosser *lesions* of the bladder and not due to irritation from infected urine, the symptoms, as a rule, are not relieved immediately and not infrequently they never disappear entirely.

Nephrectomy removes only the focus of the infection in the urinary tract. Nevertheless the removal of this large focus enables the patient to strengthen his resistance against the invading infection, and thereby aids in the cure of the remaining lesions. Unfortunately, the foe with which the patient has to contend is not easily subdued, and the fight goes over a long period of time, often ending only in defeat.

It is our purpose in this paper to consider the results of nephrectomy for the relief of renal tuberculosis as they are shown by (1) the immediate mortality rate; (2) the late mortality; and (3) the persistence of the symptoms. As will be seen, our postoperative results are very similar to those reported by Cabot and Crabtree in their recent paper.

1. *The immediate mortality rate.* The factors which influence the immediate mortality rate are: (a) *The condition of the patient at the time of operation.* If good results are to be secured, the patient must be in as good a condition as possible in order that he may withstand the shock and trauma of the operation. It is especially necessary, also, to secure the maximum function of the other kidney. (b) *The technique of the operation.* There is no doubt that the immediate mortality rate may be lowered by gentle rather than rough manipulation; by making the incision so ample that the kidney may be delivered with but slight traction; and by protecting the wound against such infection as might follow the breaking of an abscess. Since the type of anæsthesia has its influence also, we use light nitrous oxide anæsthesia, adding ether only if it is necessary.

2. *The late mortality rate.* These factors—the condition of the patient and the operative technique—influence the late mortality even more than the immediate mortality. To the extent that the severity of the operation lowers the patient's resistance will convalescence be prolonged or life endangered. Rough manipulations may make it impossible for the tissues ever to recover sufficiently to combat infection.

There is still a difference of opinion as to whether or not the ureter should be removed at the time of nephrectomy. For ourselves, we discontinued doing it some time ago for the reasons that (1) its excision adds materially to the severity of the operation; and (2) we are not convinced that the removal of the ureter helps to relieve the symptoms as long as a tuberculous lesion remains in the bladder, for if the ureter is extensively involved, the bladder also is affected.

[1] Read before the American Urological Association, St. Louis, April 19, 1916.

In the combined statistics of Drs. Bunts, Crile, and Lower, the mortality rate for nephrectomy in cases of renal tuberculosis is 2.3 per cent, while a recent series by one of us (W. E. L.), comprising over 100 consecutive nephrectomies for various lesions, shows an immediate mortality rate of less than 1 per cent. The remote mortality, in the majority of cases, has been due to tuberculous lesions in other parts of the body, such as tuberculous peritonitis, general miliary tuberculosis, and pulmonary tuberculosis.

3. *The persistence of symptoms.* We regret to say that too large a percentage of our cases still have persisting vesical symptoms, frequent urination being reported most commonly. For the relief of this condition nearly everything has been tried, but as a rule with little or no success; it should be noted, however, that in many of our patients the bladder had become so extensively involved and its capacity so reduced, that immediate relief could not be expected. In the majority of our cases the irritation was relieved, although in many cases some frequency of urination persisted. To this, however, the patient had become so accustomed that it no longer annoyed him greatly.

The necessity of prescribing a proper régimen is too frequently overlooked. Many of these patients return to the environment in which they lived during the early development of the disease—too often an environment which affords no opportunity for a hygienic régimen, by which the patient's powers of resistance may be increased. These patients must be properly advised and placed where they may have the full benefit of those factors which aid in the arrest of the tuberculous process; fresh air, good food, and congenial surroundings.

As has been noted by Cabot and Crabtree, very early cases with small multiple foci in the kidney often do not recover as promptly or completely as those cases in which there is a larger localized abscess, because in the latter, the tissues have developed a certain immunity. This fact, however, is not an argument for deferring operation, for there is always the danger that other organs may become involved by the extension of the disease, and thus far medical treatment has shown no cure for tuberculosis of any portion of the urinary tract. Prolonged treatment of these patients for other conditions is still too prevalent. A majority of the cases of tuberculosis of the kidney, which are referred to the surgeon, have been given an incorrect diagnosis and have been treated for nonexistent lesions, such as an encroachment of the uterus on the bladder, if the patient be a woman; or a specific infection, if the patient be a man. It is the duty of the urologist to educate the general profession so that they may recognize early the presence of tuberculosis of the urinary tract, and may differentiate the symptoms caused by this condition from those caused by other lesions.

STATISTICS

This paper is based on a study of the end-results of nephrectomies performed by Drs. Bunts, Crile, and Lower, the series including 87 consecutive nephrectomies for tuberculosis of the kidney. Operations performed within the last year are not included since the end-results cannot be determined.

Immediate mortality. Among these cases, there were two deaths within four weeks after the operations and before the patients left the hospital. The cause of the immediate mortality in the first case was probably shock, the patient being in a very precarious condition before operation and the removal of the kidney difficult. This was one of our earlier cases and the operation was performed without the preliminary preparation now employed. The second patient lived three weeks after operation, autopsy revealing the fact that the remaining kidney was decidedly tuberculous.

Later mortality. Of the cases showing a later mortality, two died of general tuberculous peritonitis, four of pulmonary tuberculosis, while the cause of death in the remaining four is not known. The longest interval between operation and death was seven years, this patient dying of pulmonary tuberculosis at the age of 37.

Persistence of the symptoms. Forty-five replies were received to letters sent out January 1, 1916, in which complete data on the

present condition of the patients were requested. These reports were compared with the case histories, to determine the relation of the persistent symptoms to those present before operation.

a. *Painful and frequent urination.* In 48 per cent of the cases with painful and frequent urination before operation some bladder symptoms persisted, abnormally frequent urination being the most common. The history of each of these cases showed that bladder trouble had extended over a long period prior to operation. Of the 9 per cent who reported no definite improvement in the bladder symptoms, each one had pronounced bladder involvement at the time of operation. Twenty per cent reported that they were in perfect health and all the rest that they were greatly improved. One man, who had been operated upon eight years before, reported himself as entirely cured although his history showed that for three years previous to operation, he had complained of frequent urination, a symptom which persisted for ten months after the nephrectomy.

b. *Pain in back and side.* Pain in the back of a colicky nature was reported by 12 patients, while 25 reported pain of varying degrees in the back, side, or hip.

In those cases in which there were no demonstrable bladder symptoms at the time of consultation, a definite history of bladder trouble at some previous time was always obtained. The chief complaint in these cases was either dull or sharp pain in the back. In these cases, the X-ray was a valuable diagnostic aid, while operation revealed an old caseous kidney which had resulted from either partial or complete autonephrectomy. Each of these patients made a complete recovery from his operation and was able to return to his old environment and to carry on his work as before. One case of this type was operated upon six years previous to this report and had made a complete recovery. All were entirely relieved of their former symptoms.

c. *Renal hæmaturia.* Of the entire series 44 had hæmaturia, this being the only symptom in two cases, in one of which the bleeding was painless. Where the hæmorrhage was from the kidney, it subsided after operation.

d. *Pus in urine.* The majority of the cases, in which before operation pus was present in the urine, in connection with bladder lesions, reported that this symptom still persisted.

e. *Duration of symptoms.* In our series, the shortest duration of symptoms before operation was three weeks, the longest, 19 years. Patients usually wait from eight months to three years after the appearance of the first symptoms before seeking surgical relief. We had six cases in which the symptoms had persisted more than four years, five being women and one a man, a physician. The prolonged period in the women was due, in each instance, to the fact that one or more of the genital organs, usually the uterus, was considered the cause of the trouble. In the case in which the symptoms had persisted for only three weeks, the relief was almost immediate, and the patient rapidly gained in weight. This man had remained in good health to the time of the report, a period of two years. In another case, a well-nourished, robust looking man had complained for six weeks of sharp stabbing pains in the left abdomen, associated with slight burning on urination, the first intimation of any pathological condition being the large amount of albumin present in the urine when he was examined for life insurance. Nephrectomy for a tuberculous kidney brought him immediate relief.

After operation, the duration of symptoms referable to the bladder is quite variable, three cases being recorded in which relief was immediate, and three in which the symptoms disappeared within two months. Most cases in which the symptoms have persisted for more than a year *before* operation do not experience much improvement during the first year *after* operation. Of those of our cases whose symptoms had persisted to the time of their report, only five considered themselves unimproved.

f. *Sex.* The cases in this series included 46 women and 41 men.

g. *Age.* The average age of our patients was 33; the oldest patient operated upon was

63 years of age; the youngest was 16; 46 were in the third and fourth decades of life and but nine were over 50. Our study, therefore, tends to confirm the conclusions of others that renal tuberculosis most frequently occurs before middle life. Contrary to the statistics of many urologists, the reports of our older patients were not favorable, in spite of the fact that in two of the cases calcareous deposits were found in the kidney removed.

h. *Family history.* Of our cases 18 reported the existence of tuberculosis in some member or members of their families; 43 gave a negative report; while no statement regarding this point is found in the remaining case histories.

i. *Kidney involvement.* As far as can be determined, in only two of the operative cases in our series were both kidneys involved. We are inclined to believe, however, that involvement of the second kidney is present oftener than our operative records show, for judging from autopsy records, about two-thirds of all cases are bilateral.

j. *Weight.* There are no exact records of the amount of weight lost before operation. Among our operative cases in the last five years, however, with the exception of two, one weighting 270 and the other 190 pounds, all lost weight before operation. The two greatest postoperative gains in weight were 74 and 75 pounds. Only two of our cases did not gain at all, while one reported that he was losing weight. The average gain for the 31 patients who reported regarding this point was 31.3 pounds.

k. *Technique of operation.* The early cases in our series were operated upon under ether, but during the last five years nitrous oxide with local anæsthesia has been used. The general operative technique has remained unchanged. A long oblique incision is made to give free access to the kidney, and if possible to allow its removal without rupture. Very rarely is it found necessary to fracture a rib in order to reach the kidney. The ureter is separated to a point as near the bladder as possible without making another incision, and after being ligated with chromic catgut, is cauterized either with the actual cautery or with carbolic acid. If the wound becomes contaminated with pus, or if there is much oozing, drainage is instituted.

The main consideration in the operation is to produce as little shock as possible. Shock is minimized by having the patient in good condition before operation; by losing the least possible amount of blood, and by gentle manipulation. Hæmorrhage is checked almost entirely by means of a special pedicle clamp which grasps the entire pedicle and allows the stump to be ligated with a non-slipping ligature. Every effort is made to avoid trauma and manipulation in removing the kidney, in order to impair as little as possible the resistance of the local tissues, and to prevent contamination of the wound with pus. In the earlier cases, the stump was ligated with a linen suture. This retarded the healing of the wound, since a troublesome sinus always persisted until the ligature was removed. In recent years this delay in healing has been eliminated by the use of chromic catgut.

Any type of incision and of operative procedure may be used, provided the patient is in good condition before operation, and provided that hæmorrhage and trauma are eliminated as much as possible. With the exception of the two cases already cited, each patient in our series made a good recovery as far as the nephrectomy is concerned. The persisting bladder symptoms alone gave trouble, since, of course, the operation of itself did not relieve the local lesion, except by preventing further infection from the diseased kidney.

l. *Wound healing and postoperative complications.* In 17 cases, no data in regard to wound healing were given; three reports stated that the wound had not healed; three had gained in weight and had had no trouble aside from the inconvenience of dressing the sinus. The longest period of time reported as elapsing before the wound healed was four years, the shortest, eight days. In 29 cases, the healing was complete within a month; in 21, within a year; in 16, before two years had elapsed.

Suppression of urine was not reported in

any case, and but one case of postoperative hernia.

Of our cases 8.1 per cent are classed as unimproved, this number including those who have lost in weight, those whose general condition is below normal; and those who still have troublesome bladder symptoms or active lesions in the urinary tract. The cured cases comprise 60 per cent of all, and include those who have gained in weight; those whose bladder symptoms have ceased or subsided, and those who have been able to resume their work.

CONCLUSIONS

1. Renal tuberculosis generally implies infection not only of the kidney, but of the ureter and bladder also.

2. The length of time during which bladder symptoms persist *after* operation is directly proportionate to the duration of the same symptoms *before* operation.

LIGATURE OF THE INNOMINATE ARTERY FOR CURE OF SUBCLAVIAN ANEURISM

By PAUL F. MORF, M.D., Chicago

THE first recorded ligation of the innominate artery was performed by Valentine Mott in 1818, the patient dying of sepsis and secondary hæmorrhage on the twenty-sixth day. In spite of the frightful mortality, the operation was repeatedly done, as it offered the only chance for cure of a condition otherwise hopeless.

In 1905 Sheen[1] reported a successful case and collected all the reports of successful and unsuccessful cases. He also collected reports of attempted ligations of the innominate artery. In 1915 Thompson[2] reported a case operated upon by himself which ended fatally, and brought the literature down to date. As this operation is only rarely performed, the following case operated on by myself in 1911 seems of sufficient importance to be added to the series.

F. W. T., male, aged 55, first consulted me May 20, 1911, giving the following history: For the past five or six years he has been suffering from intermittent, paroxysmal pain, beginning in the deltoid region of the right shoulder and radiating to the arm and forearm. During the last two or two and one-half years he has taken treatments for this trouble from an osteopath, consisting of massage more or less skilfully carried out. About six months ago when the pain was particularly intense, he was given an unusually vigorous treatment by the osteopath. During the manipulation, the patient states, the operator's knuckles made severe pressure in the right supraclavicular region, causing such pain that he cried out and protested against the treatment. Nothing unusual was noted at the time, but next morning a pulsating swelling about as large as a pigeon's egg showed in the right supraclavicular fossa. This swelling gradually increased in size up to the time he came under my notice, the pain in the meantime increasing *pari passu*.

Previous history. No sickness of any importance. No venereal history. Patient says before the pain began in the right arm he had for many years been employed as shipping clerk in a baking powder factory. In this capacity he daily handled many cases of goods that weighed about eighty pounds. These had to be piled on trucks and shelves and many of them lifted high above his head. Whether this muscular exertion acted as a causative factor, I am unable to say.

Physical examination showed a fairly well nourished general condition. He had a somewhat anxious expression and the face showed evidence of physical suffering. The general examination was negative, except that the radial pulse seemed rather harder than normal for a man of his years. In the right suprascapular fossa there was a swelling, fusiform in shape, about as large as a hen's egg, which was limited internally by the outer margins of the scaleni muscles. The overlying skin was unaltered and freely movable over the swelling. The tumor itself was soft and compressible. It pulsated synchronously with the cardiac systole, and on ausculation a loud systolic bruit was audible. The radial pulse was alike on the two sides, that on the right side not delayed.

Diagnosis. Aneurism of the third portion of the right subclavian artery. It was decided to ligate either the first part of the subclavian artery or the

[1] Sheen. Ann. Surg., Phila., 1905, July.
[2] Thompson. Ibid., 1915, June.

innominate for the cure of the aneurism. The gradual but steady increase in size of the tumor as well as the suffering of the patient seemed to justify this radical measure.

On May 27, 1911, the patient entered the Chicago Policlinic Hospital. The next morning, after the usual preparation, he was placed under general anæsthesia with ether. An incision was made, 13 centimeters long, beginning 6 centimeters above the clavicle. After dividing the sternal and clavicular attachments of the stenomastoid muscle the inner third of the clavicle was resected subperiosteally, and disarticulated from the manubrium. This procedure gave free access to the lower portion of the right common carotid, which was followed down to the innominate. The right subclavian artery was traced outward to the inner border of the scaleni. The aneurism was then seen to involve the second part of the subclavian. In view of the fact that the arteries of the patient showed at least a moderate degree of sclerosis, it did not seem desirable to place the ligature on the first part of the subclavian, in close proximity to the aneurism. It was, therefore, decided that the ligation of the innominate was necessary. The vessel was isolated by blunt dissection and two heavy kangaroo tendon ligatures placed and tied. A third ligature was tied about the common carotid near its origin. Pulsation ceased at once in the aneurism and also in the right radial artery. Closure of the deep parts with catgut and the skin wound with silkworm-gut followed.

The patient was in good condition at the end of the operation, which took an hour. The right arm was packed in absorbent cotton and placed in a slightly elevated position. There were no symptoms of cerebral disturbance. During the next few days there was considerable pain in the right arm, which necessitated a few hypodermics of morphine. The aneurism became hard and firm to the touch. At the end of two and one-half weeks, pulsation in the right radial was quite distinct, and at the expiration of three and one-half weeks pulsations began to reappear in the aneurism. The patient then left the hospital feeling well, the neuralgic pain having almost entirely disappeared. The hand and arm remained somewhat atrophic and stiff for three months, but persistent massage and passive motion eventually caused these to disappear entirely.

Status praesens. The patient now has occasional attacks of pain in the right arm, which are sometimes precipitated by working. The aneurism measures 6 x 5 x 4 centimeters. The wall is firm and strong except on a small area about 2 centimeters in diameter. It has increased only slightly in size. The patient expresses himself as well satisfied with the result, such as it is, and persistently refuses a further operation for excision of the sac.

Up to the present time there are on record including the case here reported 53 ligations of the innominate artery, of which 40 died and 13 recovered. Twenty-one were operated upon in the pre-antiseptic period (before 1871) with one recovery. The patient was operated on by A. W. Smythe of New Orleans in 1864 for a subclavian aneurism, both the innominate and subclavian arteries being tied. In spite of secondary hæmorrhage occurring on the fourteenth, thirty-third, and fifty-first days, the operation was followed by ultimate recovery, a ligation of the vertebral artery being found necessary on the fifty-fourth day to control hæmorrhage. The causes of death in the other cases are as follows: hæmorrhage 13, sepsis 4, shock 2, and cause not mentioned in one.

Since 1871 32 cases have been operated upon with 12 recoveries, a mortality of about 62 per cent. The causes of death were as follows: sepsis and hæmorrhage, 9; hæmorrhage, 3; cerebral lesions, anæmia, thrombosis, 4; chronic nephritis, 1; broncho-pneumonia, 1; cause not assigned, 1; and shock, 1.

Effect of ligation on the aneurism. Of the 13 cases that recovered, 11 were operated on for aneurism. Of these 11, 4 were cured permanently and in 7 the aneurism returned, in one as early as the third day, and one after ten years. Two of the cases that were cured had a ligation of the innominate and carotid, and two a ligation of the innominate artery alone. Among the cases recurred, the innominate and carotid were ligated in two instances, the innominate carotid and vertebral in one; the innominate carotid and first portion of the subclavian in one, and the innominate alone in three instances. The conclusion that must be drawn from these considerations is that the additional ligation of the carotid has little influence on the chances of a cure. To obtain this, subsequent operations have been performed where ligation of the innominate carotid has proved inadequate. Sheen ligated the second portion of the subclavian artery to obtain a cure, and Saigo[1] twice made an excision of the aneurismal sac when ligation of the innominate proved ineffectual. To obtain a higher percentage of permanent recoveries without increasing the danger to the patient may not be possible. However, it does seem that if the aneurism is sacular and not too large that Matas' method ought,

[1] Saigo. Deutsche Ztschr. f. Chir., lxxxv, 577–640.

if possible, to be tried. If this method is not adaptable to the size or shape of the aneurism, excision of the sac might be attempted; a treatment which proved successful in the two cases reported by Saigo. If neither of these two methods is possible, a distal ligation of the axillary artery in addition to the proximal ligation of the innominate, combined with the ligation of several or all of the branches of the subclavian might increase the chances of a permanent recovery.

As to the material to be used for the ligation it seems to me that there can be no question today. An absorbable, pliable ligature of generous size that will remain for three or four weeks or a little longer would seem to be ideal, and either kangaroo tendon or heavy chromicized catgut may be used. It might seem unnecessary at this period to draw attention to the necessity of strict asepsis in performing the operation. Still the occurrence of sepsis and secondary hæmorrhage, after operation, even since the beginning of the antiseptic period (cases of Gay[1] 1897 and Burns[2] 1908), serve as an excuse for emphasizing this self-evident necessity.

[1] Gay. Boston M. & S. J., 1897, cxxxvii, 73.
[2] Burns. J. Am. M. Ass., 1908, Nov. 14.

EXPLORATORY LAPAROTOMY

Its Use and Misuse[1]

By CHARLES H. PARKES, M.D., F.A.C.S., CAPT. M.O.R.C., Chicago

EXPLORATORY laparotomy is justifiable when used as a diagnostic recourse in connection with or following the use of all other available means to that end. Only after a complete and thorough examination, utilizing all diagnostic aids, may an exploratory incision be employed. By it is obtained the information which direct access to affected and correlating parts can give. Such a laparotomy obviously is a diagnostic measure, but it should be the aim, as unquestionably it is the duty, of the surgeon to limit the exploratory feature to the minimum. It then remains to determine further whether the condition found is operable or inoperable, and, if operable, what surgery is warrantable. Without careful preliminary study of the case, even the most experienced operator has no license "to go in and find out," as so often is done following the mere application of hands to the abdomen and a glance at the chart. Such superficial work deserves more condemnation for the wholesale or the occasional "cutter" than does the shotgun, cure-all dose for the "pill-vendor."

It follows, therefore, that the misuse of an exploratory laparotomy is to open an abdomen without previous complete examination. Too often it is the practice to make it a short-cut route, because of its comparative simplicity and relative safety, if it is granted that there is such a thing as a simple herniotomy or appendectomy.

Of necessity, using the knife without proper thought must plunge the wielder immediately into a period of uncertainty as to (1) what may be encountered; (2) what to do with an unfamiliar difficulty; (3) when to terminate an excursion into the unknown; and (4) how to get back to land without losing either patient or prestige. The disastrous results of this uncertainty usually are not discovered until after the termination of the ordinary hospital convalescence.

In general, modern asepsis has made exploratory laparotomy too easy and too safe. With even a limited surgical training, the aseptic habit is quickly acquired, making it possible for "fools to rush in where angels fear to tread." Immediate danger to life is greatly lessened when the work is done in an up-to-date hospital, with the protection of the rubber gloves, sterile linen, instruments and sutures afforded. The knowledge and

[1] Read before the North Central Illinois Medical Society, Pontiac, Illinois, October 1916

training of an intelligent surgical nurse are provided, an alert interne assists, and a safe, experienced anæsthetist carries the patient through the danger of prolonged narcosis. The patient rarely has any conception of the thought, care and experience involved in the routine technique which has been developed in that operating-room, and to which he owes his life. Naturally, but incorrectly, he credits this to the skill of his doctor. Therefore, unfortunately, modern asepsis has afforded an opportunity for a playground for ignorance, cupidity, and deceit.

John B. Roberts (1) says: "Reflection upon the causes of diagnostic error . . . should lead to the value of encouraging a doubting mind, and to . . . decided skepticism of the *snap* diagnosis. . . . The gynecological bulletin board announces, 'abdominal section' or 'section.' While formerly 'section' meant 'autopsy,' it is now used, I suspect, to cover a reserved diagnosis. . . . Sometimes it is the resort where doubt exists in the mind because of insufficient knowledge of the physiology and anatomy of the human organism, and a careless application of the knowledge possessed."

The constant aim in medicine should be to lower the mortality rate. Internists and surgeons alike continually strive to clip off small fractions of their percentages of fatality. Death, or even the slightest degree of invalidism, subsequent to operation seems more reprehensible than anything that happens to follow any other practice. Further, surgical responsibility does not cease with the return of the patient to his room alive, followed by a short convalescence devoid of pus; the symptoms must be cured, or at least diminished.

Were it not for daily exhibitions of operations, which resemble the results of railroad accidents, a discussion of this question would be supererogation. It is a deplorable fact that in most hospitals it is not uncommon for a doctor to enter a case, prepare for the operation, cut through the skin, peck around on the peritoneum, and then immediately beg the interne to tell him what to do next, or in a panic request him to finish the job.

Incredible as it may seem, utterly unfitted and often with full knowledge of their unfitness, many doctors will essay to operate, and, unfortunately, will continue in the practice until the future develops some plan for their repression.

By way of illustration two incidents of recent occurrence are related.

First, the case of a young woman, aged twenty-four, pregnant five months, with a marked Graves' disease, the symptoms of which dated back several years. In the history is found a record of five different operations within the last two years. It will not be hard to guess that the first of these was an incision over McBurney's point to remove the appendix. The next was through the median line, during which operation the surgeon claims to have removed the same appendix. Besides the appendix, he also took with him one tube and one ovary. The next procedure was a dilatation of the cervix and the removal of some hæmorrhoids. Then some more hæmorrhoids were burned off, and, lastly, the tonsils were "Sluderized." This patient was in two different hospitals of some reputation.

During the course of these treatments the real condition, the hyperthyroidism, never was discovered, and the patient now has a suspicious spot in the right apex, a heart poisoned almost to collapse, eyes popping out of her head, tremor so great that she has difficulty in holding a glass of water, and a uterus five months' pregnant.

Second, a woman of forty-five, with a biliary fistula of several years' standing. The history shows two laparotomies and innumerable dressings, including the use of probes and small curettes, and the long-continued maintenance of a rubber drainage tube. In this case the diagnosis seems to have been made and confirmed, as the doctor operated for gall-stones and removed two. He told the patient honestly that he felt another, but was unable to get it out. He stitched the gall-bladder to the skin and instructed the patient never to allow any more surgery, as the procedure of closing the fistula probably would prove fatal. The resulting permanent drainage was so distressing that the patient again went to the operating-table, again came out alive, but was unable to obtain any information from the second operator regarding what had been done. Her fistula still persisted, and more surgery was demanded. The fairly simple procedure of complete removal of the gall-bladder, with the stone in a pouch, relieved the condition and cured the patient.

The first of these two cases shows operative work with no thought of preceding it with an intelligent diagnosis. In the second case a diagnosis had been made, which the exploration of the abdomen proved. It shows more conspicuously, however, the unfairness to the

patient and to the good repute of surgery, where one unable to cope with a not particularly difficult condition got beyond his depth.

Where, in the category of a scientific calling, should a man be placed who exhibits a handful of gall-stones which he has just removed, but who has sent the patient away with one undiscovered in an accessible part of the biliary tract and a gall-bladder carefully stitched to the peritoneum or the skin? Or the so-called surgeon who leaves an appendix which has eluded his most careful search along the white line, even to the turn of the splenic flexure? Where does the surgeon belong whose entire bag of tricks consists of an ability to remove a normal appendix, resect or remove one or both ovaries, one or both tubes, and perhaps drain a gall-bladder? He can have no conception of respect for the vitality of tissue, especially the peritoneum; no thought of the effect of resulting adhesions, and no regard for the organic functions necessary to the future usefulness of his patient. Unfortunately, his name is Legion.

Going a step further, another group of operators thoroughly investigate and diagnose an abdominal case. Not infrequently, before opening the abdomen, they decide upon the operative procedure to be undertaken. Therefore, it happens that in their hands a gastro-enterostomy will be performed as the result of a fixed plan before operation, without an examination of the stomach itself after opening the abdomen. A thorough examination of the stomach might show it to be normal, and lead to further investigation of the abdominal contents, with the location of the pathology in the gall-bladder or perhaps the appendix, much to the benefit of the patient.

H. A. Black (2), in discussing a paper by F. Gregory Connell on "Pseudo-Appendicitis" thinks that in chronic gastric disorders there probably is greater confusion than in any other condition within the abdomen, as applied to chronic appendicitis. In these cases the roentgen ray, the test meal, or even hæmorrhage from the stomach, does not and should not convict that organ of ulcer. The absence of pain and tenderness does not absolve the appendix from possible guilt. Of course, these cases usually can be demonstrated by operation, but it is much more pleasant to be confirmed rather than confounded by our operative findings.

An abstract from an article by D. B. Pfeiffer (3), on factors influencing the present mortality of peritonitis, is interesting. He concludes, from the compiled statistics of the results of various preliminary treatments in cases of appendicitis, complicated by local and diffuse peritonitis, that, even before undertaking to operate, intelligent care, as dictated by experience, is necessary. He protests against the stereotyped methods of treatment of abdominal pain and colics. "The great pitfall for the practitioner lies, first, in the fact that many abdominal pains are not due to surgical conditions, and, second, in the difficulty of differentiating surgical disorders from the non-surgical in their earlier stages. Until a few years ago the purge was thought to be a very good introduction for the treatment of any disorder, abdominal or otherwise. When the practitioner learns to treat all cases of abdominal pain with masterly inactivity during the period of indeterminate diagnosis; when he does nothing that runs counter to the principles of treatment set forth, . . . then the subsequent morbidity, if not mortality, from the acute abdomen will approach the vanishing point."

Again quoting Roberts (4): "Potential dangers should not always lead us to take operative risks. Sometimes the anæsthetic is more dangerous than the operation. A sharp knife is more dangerous in the hands of a clever cutter than a doubting mind in the skull of a thoughtful surgeon, who believes that all problems cannot be solved by a keen edge alone. Surgery must be regarded as a science, a part of all science, and not a mere sciolistic act, if those who pose as surgical specialists wish to rank with the wise men of the earth. I freely admit my dubious mental attitude to dogmatists in surgery, science and religion. The Creator seemed wiser than authors of the latest fads in operative technique. The human animal needs tonsils, appendix, mammary glands, ovaries, uterus, and even the colon."

There is another phase of the question worthy of mention, namely, the rush of an able man with too much business. The following cases have come to my attention recently:

A patient with an indigestion went to one of the surgical mills, and was placed in a ward for diagnosis. He was receiving the attention of the roentgenologist when, on the morning of the third or fourth day, the operating force took him to the operating-room, where he was put to sleep, and his gall-bladder removed. In a short time it was found that it was a gall-bladder near-by that needed the "ectomy." Later, after proper careful scientific investigation, an internist diagnosed the case as one of appendicitis. The appendix was removed, followed by relief of the indigestion.

Two similar instances occurred elsewhere. A man in a ward, being treated for typhoid, and about convalescent, was taken to the operating-room, much against his protest, anæsthetized and his appendix removed. Fortunately, he recovered. The appendix scheduled for operation was in the next bed.

A patient was being prepared for laparotomy, and was partially anæsthetized, when apparently the thought occurred to the surgeon that he had better determine which side the hernia was on. The interne, when questioned, did not know, nor did the unwritten history sheet state. The patient was allowed to wake up, and was asked what side the hernia was on. He was then re-anæsthetized, and a brilliant herniotomy performed.

Allow me to relate one more incident illustrating a different variety of work. A referring man sent a patient to the hospital, scheduled a laparotomy, and called up the surgeon. The next morning the patient was anæsthetized and prepared, and when the surgeon walked into the operating-room, ready to begin, he noticed a peculiar odor. Instead of proceeding with "the laparotomy," he made a vaginal examination and found an inoperable carcinoma. Inquiry proved that the operation had been advised from the symptom of abdominal pain alone, and neither the referring man nor any of the hospital staff had made an examination.

Is it any wonder that we are in disgrace, and that much of our business frequently comes to us only under protest, and because there is no other relief?

Far be it from me to attempt to put a finger upon the factor at fault. The responsibility is too widely distributed for that. My desire is to emphasize the well-known fact that these evils exist. In some way, somehow, let us get together as honest, thinking human beings, and give to the patient the chance he deserves, and our profession a chance to get out of the mire. If it means a labor union let us follow the lead of our professional friends, the school teachers. If it must be group medicine, as advocated by our friends in Boston, let us endorse Cabot in his views, and put our weight behind him.

It hardly seems possible that these extremes will solve the problem, and no doubt we will continue to flounder, continue to theorize — yes, even agitate — to the time when we can get together for the benefit, not only of our patients, but also of ourselves. Confronted, as we are, with powerful insurance corporations beating down our fees, labor unions demanding free state medical service for all whose incomes are one thousand dollars or under, and our own constant efforts in preventive medicine and the elevation of license requirements for ourselves, but not for osteopaths, chiropractors, and so forth, the time has arrived for us to prove to the public, by giving them value received, that we no longer will be their football.

To escape the toe of the boot of every amateur legislator and the shyster lawyer, we must get back into a corresponding position in the mind of the public to that occupied by the general practitioner and household adviser of several decades ago. How can we expect to obtain — above all, to deserve — the respect of the public if we cannot at least respect ourselves and each other? It is the disgrace of the commonly understood exploratory laparotomy and kindred procedures — surgical, obstetrical, venereal, laryngological, etc. — which often prompts the layman, and frequently the doctor, to think of medicine as a fake, thus encouraging the Christian Scientist, and his kind.

In conclusion, I will submit that.

1. Exploratory laparotomy has a more limited place than usually accorded it, and that place is as a scientific diagnostic procedure, only to be undertaken when other diagnostic aids have proved inadequate.

2. Following its diagnostic employment, it should be taken advantage of to determine the possibilities of operative treatment.

3. In acute conditions it should be preceded more often by careful treatment as well as diagnosis.

4. It should not be undertaken unless the operator has the qualifications, resulting from preliminary training and experience, to carry out to a successful termination, expeditiously and safely, any maneuver of operative technique demanded by any abdominal conditions whatsoever.

5. Before operating, the surgeon should have a keen sense of respect for tissue, appreciation of the value of organs to the human economy, accompanied by a reverence for delicate manipulation and horror of tissue mauling.

6. The careful planning of an operation before making the incision is wise. However, it should not be so fixed as to be inflexible should direct examination demand a change.

7. In surgery the only place for haste is in the technique developed by experience, governed by the fact that the shorter the period of the anæsthetic and manipulation, the less the shock. Haste and its accompanying carelessness, due to an ambition for a time record, or to a rush of business, are inexcusable.

8. Operation following a hasty diagnosis on the part of the surgeon himself is deplorable. Operation without personal examination, on the diagnosis of a referring man, seems incredible, but it is practiced, nevertheless.

9. The future should hold some intelligent, honest, comprehensive reform for the elevation of the ethics of surgery. The law of the survival of the fittest will not solve the problem. Organizations among surgeons themselves can be only a beginning. Legislation never has abolished evil in society and politics, and cannot do so in medicine. Reform is needed, and it must come, as do all lasting, useful reforms, by spontaneous realization on our part of the harm done us by unintelligent and dishonest practice.

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CONGENITAL ABSENCE OF THE UTERUS AND VAGINA

With Report of Six Cases

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CONGENITAL absence of the uterus is a sufficiently rare anomaly to justify this report of six additional cases. Four of these have occurred in the gynecological department of the Johns Hopkins Hospital in the quarter century of its history, while the other two have recently come under my observation in private practice. According to Burrage (1), the first instance of this condition was described in 1572 by Realdus Columbus. Since that time several hundred cases have been reported in the literature. Most of the reports, unfortunately, are very brief and usually incomplete, sometimes leaving doubt as to the correctness of the diagnosis.

ETIOLOGY

When one considers the embryology of the generative tract in women, it is easy enough to explain the mechanism, so to speak, of practically any of the numerous anomalies which may occur in this part of the body. The underlying cause for these malformations, like that of malformations and monstrosities in general, is of course still unknown. It should be remembered that from an embryological point of view the female generative tract consists of three segments. The lowest of these, comprising the vulva and the lowermost portion of the vagina, is developed largely from the external epiblast of the body (the genital tubercle, genital fold, and genital

furrow). The middle segment, embracing the uterus, tubes, and vagina, is formed by the fusion of the muellerian ducts, while the uppermost segment, i.e., the essential organ of sex, the ovary, is formed from the so-called genital ridge on the mesial surface of the wolffian body (Mall and Keibel). Absence of the uterus is clearly due to a failure of development of that portion of the muellerian ducts whose fusion normally forms the uterus.

In the great majority of cases the defect involves also the lower portion of the muellerian ducts, so that absence of the vagina is usually associated with absence of the uterus. Abnormalities in the development of the lower embryonic segment are responsible for the anomalies of the external genitalia which are found in various forms of pseudohermaphrodism. True hermaphrodism, on the other hand, involves the uppermost segment, presupposing an anomaly in the development of the essential sex glands, i.e., the ovary or testis. With the latter two groups of maldevelopment, however, we are not directly concerned in this paper.

Influence of heredity. While there is no reason, in the great majority of reported cases of absence of the uterus, to assign any important rôle to hereditary influence, there are, nevertheless, a certain number of instances in which this factor appears to have been, to say the least, not negligible. For example, Boston (2) reports a rather remarkable trio of cases occurring in three sisters. Two were single, being aged 22 and 27, respectively. The third was a widow of 33. In all three the vagina was present, but the uterus was absent. The same author mentions two other cases occurring in two married women who were cousins. Phillips (3) records two cases in two sisters, both of them married, while Squarey (4) speaks of the cases of three sisters who had never menstruated. Nelson (5), finally, reported three cases of absence of the uterus occurring in three of a family of 5 sisters.

PATHOLOGY

Menstrual molimina. A review of the reported cases of absence of the uterus impresses one with the frequency with which, in the absence of menstruation, these patients complain of definite molimina. In 4 of my 6 cases, there was a definite history of regularly recurring monthly attacks corresponding to the periods of normal menstruation. The symptoms complained of by the patients were pain or heaviness in the lower abdomen, backache, and usually more or less headache. This has been the common observation in most of the other recorded cases. To me the occurrence of definite menstrual molimina in these cases of complete absence of the uterus is a matter of considerable interest. It is, I believe, the common impression that the subjective local symptoms of menstruation are due to the pelvic congestion associated with the process. It would, therefore, seem that even when the uterus is absent, a periodic pelvic hyperæmia still occurs, the only difference from the normal being that there is no menstrual overflow by way of the endometrium. It seems obvious, therefore, that the ovaries, when present in these cases, as they almost always are, functionate quite normally, ovulation proceeding with regular rhythm, with the formation of the corpora lutea which are responsible for the menstrual phenomenon (6). It would be interesting to have the opportunity for careful histologic study of ovaries removed from such cases.

Vicarious menstruation. Although no mention is made of vicarious menstruation in the majority of case reports of this anomaly, nevertheless the number in which it has been noted is sufficiently great to justify the statement that this phenomenon is certainly more frequent when the uterus is absent than when it, and the vagina, are present. As a rule, it takes the form of nosebleed, as in the well-marked case reported by Gillmore (7). Occasionally, a bloody discharge from the bowel has been noted as occurring each month, as in the cases of Hedley (8) and Harlan (9). In the latter's patient, each menstrual molimen was followed by a "bloody flux" lasting several days. The occasional occurrence of one form or another of hæmorrhage, it need scarcely be said, does not constitute vicarious menstruation. The term should be confined only to extragenital hæmorrhage which regularly accompanies or supplants the normal menstrual discharge.

General development. As far as the general characteristics of the individual are concerned cases of absence of the uterus are of two general types. In the larger group, illustrated by the first five of my cases, the genital defect is the only abnormality exhibited by the individual. In every other way the development and characteristics are typically feminine. In a smaller group of cases, however, there is a more or less pronounced admixture of the masculine element, the extreme form being found in instances of true hermaphroditism. In cases of this kind there is usually associated some form of ambiguous malformation of the external genitalis, and not infrequently a single or double hernia of the genital gland — the ovary or testis, as the case may be. A large number of cases of this type have been collected by Mary Putnam Jacobi (10), Swasey (11), and others.

Sexual function. In the great majority of reported cases in which any mention is made of the sexual function, sexual feeling is described as being normal. Not infrequently the urethra is found enormously dilated, indicating its utilization for purposes of coitus. Jacobi, however, is inclined to believe that the apparently large urethral canal in many cases really represents a persistent urogenital sinus. Hedley (8) points out that the dilatation of the urethra by attempts at coitus is initiated by a drawing downward of its orifice into the pit of the rudimentary vagina, bringing it directly into the line of pressure.

Associated anomalies. In not a few cases, as has already been stated, absence of the uterus is associated with hernia of one or both ovaries. Another anomaly which should be borne in mind, when absence of the uterus is discovered, is misplacement of the kidney. An interesting case of pelvic kidney in association with absent uterus has been reported by Cullen (2), and a somewhat similar instance is recorded by Brettauer (13). In both of these cases the renal anomaly, though unsuspected beforehand, was fortunately recognized at operation, and thus removal of the kidney averted. The importance of this lies in the fact that in both these cases the displaced kidney was the only one possessed by the patient. A similar anomaly in a case reported by Polk (14) was not recognized until after removal of the single kidney, with, of course, a fatal termination. In at least one case described in the literature, that reported by Bullard (15), absence of the uterus was associated with what seems to have been a persistent cloaca. The vulva and the vaginal orifice were normal. When the finger was passed into the canal for 2.5 or 3 centimeters, it came to an annular constriction, evidently the internal sphincter of the rectum. When the patient was told to contract the sphincter, the grasp on the finger was quite perceptible, though not as strong as that of the normal sphincter. Just beyond the constriction were moulded fæces and a roomy rectum.

DIAGNOSIS

While in a certain number of cases the diagnosis of absence of the uterus can be made without anæsthesia, it is questionable whether the latter should ever be omitted in order to establish definitely the existence of the anomaly. Aside from sparing the sensibilities of the patient, the anæsthetic affords an opportunity of making a far more thorough and satisfying examination than can possibly be made without it. There are some who would claim that in practically all these cases the uterus is really present, but is exceedingly rudimentary. The findings in Case 3 of my series, which came to laparotomy, would seem to disprove this. At best the contention is largely an academic one, for certainly a uterus which cannot be palpated or perhaps even seen, which lacks function, and which is associated with absence of the vagina, may be looked upon, from the patient's point of view, as absent. The confirmatory value of laparotomy in the diagnosis of such cases, provided some definite indication exists, is obvious.

INDICATIONS FOR TREATMENT

I shall not discuss at any length the treatment of this condition, except to summarize my own convictions. The circumstances of the individual case must, after all, be the principal governing factor in its management. In the case of the single girl in whom absence of the uterus and vagina is diagnosticated,

it is the duty of the physician to explain the condition fully to the patient or to her parents, so that an intelligent decision may be made as to the course to be pursued. The willingness or unwillingness of the patient to sacrifice the possibility of marriage is, as a rule, the factor which leads her to decide as to whether or not an operation is to be attempted for the making of an artificial vagina. When the relative risk and the uncertainties of complete success are impartially presented, I believe that in the majority of cases, as in the one recently observed by me (Case 1), the patient will decide against operation, especially in view of the impossibility of her ever bearing children.

If, however, the desire to be able to assume the marital relation leads a patient to decide upon operation, there would seem to be no question as to the justification of the surgeon in performing it. These remarks, I need scarcely say, apply only to the cases in which both uterus and vagina are absent. The presence of the vagina, although the uterus is absent, makes the problem an entirely different one.

In the less frequent cases in which absence of the uterus and vagina is found in women who are married, both husband and wife will usually consent to the performance of an operation which can scarcely fail, if properly performed, to remove more or less completely the bar to coitus. If there is sufficient vaginal canal to allow of satisfactory coitus, as in my Case 2, there is no need for surgical interference.

Operative treatment. When it has been decided to resort to the making of an artificial vagina, several methods present themselves for consideration. The old method of dissecting the perineal body between the bladder and the rectum, and inserting a plug to keep open the canal thus made, has very properly been discarded, inasmuch as cicatricial contraction of the newly made vagina is the invariable result. The method which has been employed in perhaps the majority of cases has been to utilize the pudendal tissues, and perhaps even the skin of the thigh, to line more or less completely the canal made by separating the bladder from the rectum. Various modifications of this general method have been described by Burrage, Ferguson, Carson, and others. Aside from their uncertainty, all these methods possess the disadvantage that a canal lined with dry skin can never be considered an altogether satisfactory functional substitute for the normal vagina, with its moist lining of mucous membrane. While mucous membrane may in time, through the process of hornification, assume the characteristics of skin, the reverse is not true.

For this reason, as well as for other advantages which it possesses, the operation described by Baldwin (16) in 1904, and again in 1910, would seem to commend itself. In this operation a loop of small intestine, the ileum, is utilized for the making of the new vagina.

A transverse perineal incision is made at the site of the vaginal outlet. The perineal tissues are dissected between the bladder and rectum, until the peritoneum is reached. The abdomen is then opened, and a loop of ileum, about 12 inches long, is carried down with its mesentery into the cleft made from below, the peritoneum having of course been opened. The ends of the loop are severed from the ileum above, the two cut ends of the latter being anastomosed with a Murphy button. The loop of bowel which is to form the vagina is closed off above, the peritoneum being sutured above the cut ends. The lower end of the loop is opened, the bowel wall being sutured to the skin edges. After a number of weeks the septum between the two segments of the loop is removed. Baldwin reports that in the six cases in which this place of operation had been tried, up to 1910—four of his own, one reported by Mori, and one by Mueller—the functional result had been excellent. There had been no mortality, although the operation is obviously one of some magnitude.

CASE 1. L. S., a white girl of 20, single, was referred to me by Dr. B. S. Hanna, May 29, because she had never menstruated. She had always been somewhat frail, but had never suffered from any severe illness. The family history was of no special significance, except that her mother had not commenced to menstruate until the age of 17, and one aunt not until the age of 20. The patient herself

had always enjoyed comparatively good health, her only complaint being of "nervousness." Once every 4 weeks, for a period of from 4 to 7 days, she suffered with pain and heaviness in the lower abdomen and back, together with a pronounced exaggeration of her nervousness. There had never been any periodic nosebleed or other form of vicarious menstruation.

The patient was a girl of slender build, 5 feet and 5 inches tall, and weighed 110 pounds. The mucous membranes were of good color. The breasts were fairly well developed, and the axillary hair normal in amount. The heart, lungs and thyroid gland were all normal, the pulse usually ranging from about 80 to 90. It was thought that the non-appearance of the menses might be due to an imperforate hymen, and pelvic examination was therefore advised.

The hymen was found to be intact but not imperforate, there being a tiny orifice about 5 millimeters in diameter leading into a blind pouch about 1 centimeter deep. Bimanual examination, with one finger in the rectum, showed an entire absence of the uterus, although both ovaries were palpable. In order to study the condition more thoroughly, the patient was admitted to Mercy Hospital, where an examination under ether was made on June 1, 1915. The above findings were confirmed. In order to establish definitely the absence of a vaginal canal, an incision was made through the hymen extending downward from the rudimentary pit above described. This was deepened so as to open the perineal body, but no vaginal canal was found. Clippings from the tissue lining the cleft showed no trace of epithelium.

Bimanual examination again indicated the entire absence of the uterus. Nothing was to be felt in the normal position of the latter except a delicate transverse band-like structure, as if there were a fusion of the round ligaments of the two sides. Both ovaries were easily palpable, being of average size and freely movable.

CASE 2. Mrs. W. P., age 21, married, was referred to me on October 28, 1916, by Dr. B. V. Kelly, her complaint being of sterility and of non-appearance of the menstrual flow. Her family history was negative. For several years the patient had suffered with petit mal, being taken several times each day with "spells," during which her mind became a complete blank for a period of several months. Otherwise her previous health had always been good. She had been married 4 years, and, according to her statement, had been able to fulfill her marital duties, sexual feeling being moderately well developed. Menstrual molimina had not been noted. The patient was of slight build, 5 feet 4 inches tall, weighing 110 pounds. Breasts and thyroid were normal, and the pulse was 90 at the time she was seen.

On examination, the vulva was found to be perfectly normal. The hymen was absent, and the vaginal orifice seemed to be of normal caliber. On introducing the finger into the canal, however, it was found to end blindly at a depth of 3.5 centimeters, the upper two thirds of the vagina being absent. The vaginal mucosa was normal in appearance, the characteristic transverse corrugations being well marked. Toward the upper end of the vaginal pouch there was some narrowing of the canal, the blind end being quite smooth, with no trace of a cervix. By bimanual examination a tiny nodular thickening could be palpated at the usual site of the uterus, the ovaries also being palpable. There was no apparent connection between the rudimentary vagina and the tiny nodule just mentioned. Inasmuch as the patient was very tractable and the abdominal walls soft and thin, it was not considered necessary to subject her to examination under an anæsthetic. Coitus having been carried on with satisfaction to both husband and wife, no treatment seemed to be indicated.

CASE 3. G. D., (Gyn. No. 19542), a white girl of 18, single, was admitted to the gynecological clinic of the Johns Hopkins Hospital on July 31, 1913. Her complaint was that there had been no appearance of the menstrual flow. There was nothing of significance in her family history or in her own previous history. For one year the patient had suffered with attacks of pain in the lower abdomen and occipital headaches, these symptoms appearing regularly once a month and lasting several days. She had been examined by a physician and told that the hymen was imperforate.

The patient was well nourished, and of normal build. The lips and mucous membranes were of fairly good color. The abdomen was of normal outline, the breasts well developed, and the axillary and pubic hair normal in amount and distribution. The thyroid was easily palpable, but there was no tachycardia or other indication of hyperthyroidism. There was considerable tenderness in the right iliac fossa.

On August 4, 1913, a thorough examination was made under anæsthesia. The clitoris, the labia majora and minora, and the urethra were all quite normal. The hymen was apparently completely closed, though there was no bulging. The vagina was almost completely absent, being represented by a small tract 3 centimeters in length and with the diameter of a uterine sound. By bimanual examination, with one finger in the rectum, the adnexa were felt, but no uterus could be made out.

In view of the pain and tenderness over the right iliac fossa, it was thought wise to open the abdomen. The uterus was completely absent. Both tubes and ovaries were present and quite normal, the tubes being slightly larger and their walls somewhat thicker than the average. Mesially they tapered to a mere cord, running forward and blending with the round ligaments, which formed a band across the pelvis just beneath the base of the bladder. The appendix was moderately distended, and was removed.

CASE 4. A. M. (Gyn. No. 11076), colored, age 17, was admitted to the gynecological clinic of the

Johns Hopkins Hospital on February 23 1904. She had never menstruated. Every month, for 3 or 4 days, she suffered with pains in both ovarian regions, backache, and headache. There is some pain in the intervals, also, especially on walking and bending. There has never been any nosebleed.

The patient is a healthy looking negress. The gums and mucous membranes are of good color, the breasts well developed and firm.

Under ether an examination was made the day after her admission. The pubic and axillary hair was moderately well developed. The labia majora and minora and clitoris were normal. The urethral orifice was enlarged and reddened, the opening of Skene's ducts being somewhat enlarged and giving off a small amount of purulent discharge on squeezing. The hymen was apparently imperforate. Bimanual examination, with a finger in the rectum, showed complete absence of the uterus and vagina. A transverse band could be felt behind the bladder, giving an impression as of a fusion of the broad ligaments in the absence of the uterus. The tubes were not palpable, but a normal-sized and fully movable ovary could be felt on either side. No operation was done.

CASE 5. M. C. (Gyn. No. 10138), white, age 16, was admitted to the Johns Hopkins Hospital on December 12, 1902. She had been in bad general health for 3 years, and to this was attributed the non-appearance of the menses. Every month, for these 3 years, she had complained of severe aching in the back and lower abdomen, together with headache. This discomfort lasted 2 or 3 days. The last such attack had occurred 2 weeks previously.

The patient was a fairly well nourished girl, the face being rather pale, but the mucous membranes being of a fairly good color. Hæmoglobin 75 per cent. Heart and lungs were normal. There was some tenderness in both iliac fossæ especially the left. On this side, just above the upper half of Poupart's ligament, was an indistinct roundish mass.

The external genitalia were normal. There was no vagina, its site being marked by a little pocket, one-half inch deep and scarcely wide enough to admit the little finger, just below and a little to the right of the urethral vestibule. By rectal examination no uterus could be found. Both ovaries were palpable, and were of normal size.

CASE 6. L. P. (Gyn. No. 5916), white, single, age 20, admitted to the Johns Hopkins Hospital on March 6, 1898. Family history was negative, except that menstruation had appeared rather late in the case of her 3 sisters, at the ages of 15, 16, and 17 years respectively. A great aunt had not menstruated until after the age of 19. The patient had long been subject to headaches, but there was no regular periodicity in their recurrence. With the exception of a slight blood tinging in August of 1897, there had never been any vaginal bleeding. This tinging followed marked fatigue and was not looked upon as a menstrual discharge. In April, 1897, there was frequent nosebleed, but none since. Frequent attacks of nervousness and depression were complained of.

The patient was rather tall, of slender build, with very little subcutaneous fat. There was an absolute lack of the characteristically feminine rotundity of the figure, which was in a general way cylindrical in shape. This was indicated by the fact that the bust measured 71.5 centimeters, the hips between the crests of the ilia 73 centimeters, and the thighs between the trochanters 86 centimeters. There was apparently an entire absence of gland tissue in the breasts, the areolæ lying flat on the muscle. The nipples were only 5 millimeters in diameter, and were elevated only about 1 millimeter above the surface.

Examination under ether was made on March 7, 1898. The mons veneris was small and contained little fat. Only a few scattered hairs, 3 to 4 centimeters long, marked the skin of the mons. The labia majora were of the type of a girl of 13 or 14, before puberty. Like the mons, they were covered with a light capillary growth. The clitoris was normal. The labia minora were infantile, measuring 2 centimeters in length and 3 millimeters in width. The urethral orifice was found at the apex of a little pit. The vagina was represented by a depression 2 centimeters deep. Bimanually, with one finger in the rectum, there was no trace of vagina, uterus, or ovaries. There was, however, at about the middle of the pelvis, a sharp border running across from side to side. In the right inguinal region there was an ovoid body about 3 x 1.5 centimeters in the position of the external ring. It could be displaced downward into the right labium, but could not be put back into the abdominal cavity. This body was obviously one of the sexual glands, although its exact nature, whether ovary or testis, could not be determined.

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15. BULLARD. J. Am. M. Ass., 1898, xxxi, 479.
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PRINCIPLES GOVERNING THE SPONTANEOUS REPAIR AND OPERATIVE CLOSURE OF VESICOVAGINAL FISTULÆ

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I. INTRODUCTION

To master the technique of vesicovaginal fistula operations requires a longer apprenticeship than any other individual operation practiced in gynecological surgery. Complicated cases, even in experienced hands, may require repeated operation. If the bladder sphincter has been totally destroyed, it may prove impossible to restore continence. The current explanation offered for the difficulty encountered in the cure of vesical fistulæ is that inaccessibility of position, the abundance of scar-tissue formation, the constant wetting by infected urine, etc., hinder union. Nevertheless, as is well known, many even large fistulæ resulting from childbirth and occurring in the infected birth canal amid bruised and sloughy tissues, heal spontaneously, while others, often much smaller in size, prove refractory to repeated operations. The same lack of uniformity in behavior applies to fistulæ resulting from operative interventions, such as those following vaginal or abdominal hysterectomy.

The cause of this difference in the behavior of vesical fistulæ has become clearer to the writer during the course of the last few years, since he has studied the nature of the injuries in individual cases. Comparison of those cases which healed spontaneously with those which failed to close without operation, bears testimony to the fact that whenever the bladder was freed and mobilized (either spontaneously during the progress of labor or purposely during the course of operation) spontaneous healing occurred more frequently. Apparently the combination of two factors favors repair — mobilization allows the bladder to contract and thus to diminish the size of the opening, and mobilization also favors the gliding and displacement of the tissue planes one upon another, so that broad raw areas come into apposition. These two factors play a rôle far more important than the method of suture or the material used for approximation. The writer is, in fact, convinced that bladder defects with the exception of those at the neck will heal without suture, if these two requisites are met.

This paper aims to show how these principles can be applied, more largely to our operative technique, so as to improve both the certainty of result and to standardize the operative procedures.

Since gynecological surgery has become more widespread and popularized, it is practiced not merely in large centers, but also in the small towns and villages. Therefore, individual operators can no longer expect to obtain the same wealth of clinical material, as the pioneers in the field of vesicovaginal surgery disposed of. Consequently it is even more important today that the occasional operator have at his disposal methods which require little or no special training. Sims (1), the father of the fistula operation in America, does not mention the number of cases he operated upon, but Emmet (2) gives a casuistic of 128 cases, and Gustav Simon at Rostock (3) during the course of a few years treated 40 cases.[1]

Although advances in obstetrics have greatly lessened the occurrence of vesicovaginal fistula due to childbirth, the great increase in the number of pelvic operations has multiplied the incidence of postoperative fistulæ to a degree which even today makes this serious affliction not too uncommon.

The basic literature is contained in the works of Sims, Emmet, and Simon just referred to. The later literature is readily accessible in works such as Veit's *Handbuch* (Stoeckel 5), and Kelly's *Operative Gynecology* (6), while the more recent volume of

[1] A more recent large and interesting casuistic covering a period of 25 years appeared from Tauffer's clinic in Budapest (Toth, 4). 158 cases were seen during that period, of which 131 were treated by operation, 71.5 per cent being cured. No real improvement in the treatment of complicated conditions can be noted, if those patients operated upon in the earlier periods are compared with those observed in more recent times. This would indicate that the improvement in the treatment of vesicovaginal fistula has not kept pace with the other advances in gynecological surgery.

Kelly and Burnham (7) gives a concise résumé of all of the standard methods of operating. Further and more detailed reference to the literature will, therefore, be dispensed with, as much of it is solely of casuistic interest.

II. CASUISTIC

The casuistic upon which this article is based comprises 22 cases, including three fistulæ which healed spontaneously, and three cases of incontinence due to injury of the sphincter vesicæ, without communication with the vagina. Almost every conceivable form of fistula was encountered, from small simple openings to complicated injuries which entailed loss of the entire neck of the bladder and urethra. One vesicocervicovaginal fistula, and a fistula perforating a transverse vaginal septum are included in the series.

These cases were admitted to the First Gynecological Service of Mt. Sinai Hospital (attending gynecologist, Dr. J. Brettauer) and were operated upon by Dr. Brettauer, the late Dr. S. M. Brickner, Dr. S. Geist, and the writer during the course of the last 12 years. Upon 19 patients 38 operations were performed. Of these patients 14 were discharged cured, one greatly improved, three improved, and one unimproved. *It should be emphasized, that of the 5 patients not cured, 4 had been previously operated upon from one to six times before admission to the hospital.* This fact is mentioned because it demonstrates the great responsibility assumed by an operator who undertakes the repair of fistulæ. An illy planned or badly executed operation, especially an operation which sacrifices normal tissues, may convert a curable condition into an incurable affliction. Short extracts from the histories serve to illustrate the difficulties encountered, and also furnish sufficient comment on the errors to be avoided and the principles this article aims to emphasize.

HISTORIES

Case 1. T. W., age 35, suffered an infection after labor. Three months before admission, trachelorrhaphy had been done. Following this there were paravaginal exudates and abscesses which, at intervals required incision through the vagina, perineum, and above left Poupart's ligament. Necrosis of bladder followed after through-and-through drainage. The fistula was inaccessible. After the suppuration had ceased complete suprapubic hysterectomy was done together with transperitoneal suture of the bladder. Cured.

Case 2. A. N., age 25, had had a complete hysterectomy for fibroids at the fifth month of pregnancy, five months before admission. There was an opening in the fornix ¼x½ inch; flap-splitting operation; cured. Reopening of fistula during coitus. Repetition of operation, cured.

Case 3. B. G., age 26. At age of 13 was operated upon for hæmatocolpos. One year previously had been operated on at the Mt. Sinai Hospital for *transverse vaginal septum*, situated close to the cervix (crucial incision). Four months before present admission, labor had been induced for dead fœtus. Since then there had been a leakage. The cervix was hidden by recontracted septum. In the anterior part of septum there were two small fistulæ which above the septum led into both bladder and cervix. The septum was split. Sims' operation. Cured.[2] (Figs. 1 and 2.)

Case 4. A. S., age 35. A fistulæ developed after complete hysterectomy for fibroids with an opening 4 centimeters in diameter. *Flap splitting*, cured. Later a vesical stone developed and repeatedly reformed. (For further history see paragraph dealing with "Diverticula and Stone Formation.")

Case 5. R. H., age 39. A fistula appeared after panhysterectomy for diseased adnexa due to necrosis of vault. Suprapubic transperitoneal liberation of the bladder revealed much exudate, and a small fistula remained. On second admission, a flap-splitting operation was done and the patient was cured. This patient developed a collarbutton-shaped stone. (For further history see "Diverticula and Stone Formation.")

Case 6. M.S., age 21; 6 weeks previously operated upon for cervical stenosis and hæmatometra, since which there has been leakage. In front and above the scarry cervix there is a slit-like fistula ½ centimeter long. Bladder was mobilized by cutting through the cervical tissue and the defect was sutured. The anterior lip of the cervix was split and sutured, thus transposing the external os into the neighborhood of the internal os. Cured. (Fig. 3.)

Case 7. C. B., age 50, had had a panhysterectomy for persistent meno- and metrorrhagia, since which there has been leakage. Readmitted to hospital after 6 months, at which time there were two small openings in opposite angles of the vaginal scar. The bladder was partly mobilized and the openings sutured. A small opening developed in the center of the scar. Sims' operation, was done, minute leak. Cure by intravesicular cauterization (D'Arsonval current).

Case 8. F. S., age 51. Leakage had been present since Wertheim operation for carcinoma of uterus. Five months later a small opening near

[2] This case was published by S. M. Brickner in the N. Y. M. J., 1909, Jan. 23.

Case No.	Year	Patient	Vesicovaginal	Vesicocervical	Vesico-urethro-vaginal	Incompetent sphincter	Cause of Injury	No. of Operations before admission	No. of Operations in Mt. Sinai Hosp.	Result	Nature of Operations for Repair of Fistula	Remarks
1	'07	T. W.	+				Necrosis after repeated inc. and drainage of paravaginal abscesses	0	1	Cured	Complete hysterectomy and suprapubic suture	Suppuration of the pelvic connective tissue preceded operation.
2	'08	A. N.	+				Hysterectomy for fibroids	0	2	Cured	Flap splitting	Large defect: reopening of first scar in consequence of early coitus.
3	'08	B. G.	+				Abortion at sixth month tearing transverse vaginal septum	0	1	Cured	Sims	Before the fistula could be exposed, the septum had to be incised.
4	'12	A. S.	+				Hysterectomy for fibroids	0	1	Cured	Flap splitting	A vesical calculus developed subsequently in a diverticulum.
5	'12	R. H.	+				Hysterectomy for diseased adnexa: drainage	0	2	Cured	1. Suprapubic laparotomy 2. Flap splitting	Necrosis following vaginal drainage caused the leak; stone formed in diverticulum.
6	'13	M. S.	+				Cervical plastic to relieve hæmatometra	0	1	Cured	Liberation of bladder	The bladder was transposed to above the internal os.
7	'13	C. B.	+				Complete hysterectomy for meno- and metrorrhagia	0	2	Cured	1. Flap splitting 2. Liberation of bladder	Three minute fistula cured by intravesical cauterization.
8	'14	F. S.	+				Wertheim hysterectomy for cancer	0	1	Cured	Liberation	
9	'15	G. B.	+				Difficult labor	0	1	Cured	Combined operation; hysterectomy and suprapubic hysterectomy	Inaccessible fistula: operation declined at 2 hospitals. Suture did not hold.
10	'16	D. S.	+				Ligation of tubes *per vaginam*	0	1	Cured	Sims	Ligation of tubes performed for tuberculosis. Gas oxygen narcosis.
11	'13	M. B.		+			Difficult labor	0	1	Cured	Liberation of bladder	
12	'04	R. G.			+		Difficult labor	0	4	Unimpr.	3. Gersuny: 1 plastic at bladder neck	
13	'08	I. S.			+		Followed a laparotomy	1	4	Impr.	3. Gersuny: 1 plastic at bladder neck	Paraffine injections repeatedly.
14	'11	L. M.			+		Difficult labor	1	5	Impr.	5. Flap operations	Flaps necrosed after each operation.
15	'12	S. S.			+		Bladder injured at cystocele operation	6	3	Improved	Reconstruction of urethra and neck	Some degree of continence with pressure pessary.
16	'14	J. W.			+		Bladder injured by pubiotomy	2	5	Much imp.	Bladder completely closed, new false passage	Still under treatment.
17	'12	F. K.				+	Difficult labor	3	1	Cured	Liberation of bladder; suture of sphincter	
18	'14	R. G.				+	Trauma	1	1	Cured	Liberation of bladder, suture of urethra and sphincter.	
19	'15	A.				+	Incontinence developed after menopause	0	1	Cured	Liberation of bladder; suture of sphincter	
20	'03	E. H.	+				Difficult labor	0	0	Cured	None	Spontaneous closure after bladder irrigation 2½ months postpartum.
21	'16	R. F.	+				Complete hysterectomy for cancer of fundus	0	0	Cured	None	Spontaneous closure followed use permanent catheter after 14 days.
22	'07	E. L.	+				Complete hysterectomy for cancer of cervix; bladder opened and sutured	0	0	Cured	None	Spontaneous closure followed use permanent catheter after two weeks.
		Total	13	1	5	3		6	19			

17 patients were cured, 1 was much improved, 3 were unimproved, and 1 was not improved.

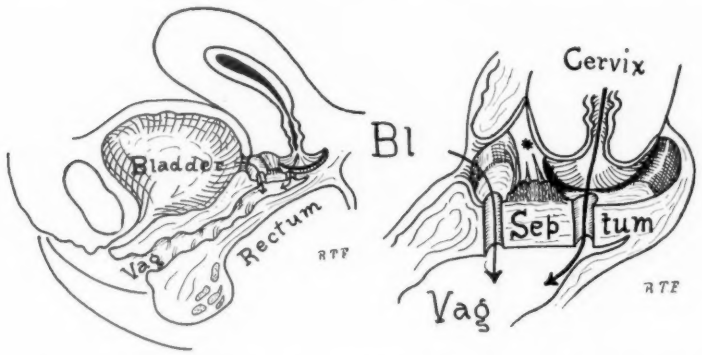

Fig. 1. Case 3. Fistula through transverse vaginal septum. Sagittal section showing vesicovaginal fistula and communications for urine and uterine discharge.
Fig. 2. Case 3. Same as Fig. 1, region of fistula and cervix drawn on larger scale. Asterick on section of dense adhesions separating vesical and uterine openings.

the fornix was closed after full mobilization of bladder; cured. No recurrence of carcinoma up to present (2½ years). (Figs. 4, 5 and 6.)

CASE 9. G. B., age 25; 4 children alive; last, difficult labor; 5 months previously stillbirth, since which there has been leakage. Operation refused at two hospitals because of situation of fistula (?), "declared incurable." Projecting red mass above and to right of cervix fixed to fornix and pelvic wall. Attempt to mobilize from below had to be abandoned because of uncontrollable hæmorrhage. *Suprapubic, transperitoneal laparotomy,* complete hysterectomy and right scalpingo-ophorectomy (for technique see "inaccessible fistulæ"), freeing of bladder by sharp dissection from right pelvic wall after ligation of right uterine artery far laterally and freeing of ureter, suture of gauze into bleeding parametrial area, incomplete suture of bladder. Leakage. Permanent catheter for 28 days. Cure. (Figs. 7, 8, and 9.)

CASE 10. D. S., age 35; 6 months before admission induced abortion (because of tuberculosis); a few weeks later ligation of tubes *per vaginam,* since which there has been leakage. There was a very small opening one-half inch above the cervix. Sims' operation; cured.

CASE 11. M. B., age 19, induced labor at eighth month because of eclampsia; since then leakage. Urine dribbles from cervix through a small opening one half inch above external os. The bladder was fully mobilized and the opening and cervix sutured. Cured.

CASE 12. R. G., age 27; 2 children alive; last child stillbirth, difficult labor; since then leakage, urethra torn. Behind the tear are two small vesico-vaginal fistulæ a plastic was performed on urethra and the fistula closed; later three Gersuny operations were done (liberation and twisting of urethra on its longitudinal axis). Unimproved.

CASE 13. I. S., age 29; leakage followed laparotomy "for adhesions," one operation for fistula before admission at which opening was closed but incontinence continued. Three Gersuny operations, unsuccessful. Repeated hard paraffin injections; some improvement. Exposure of bladder neck, evacuation paraffine pockets, sutures to narrow neck. The patient remained about the same; continence imperfect.

CASE 14. L. M., age 27. Leakage had persisted since difficult labor 10 months before; one operation had been done for fistula before admission. The cervix was buried in scar tissue and there was a defect of the lower half of the urethra and anterior bladder wall. (1) A vaginal flap plastic was done but did not heal. (2) Double Schuchard incisions were made, two fistulæ were united and the hole closed, leaving a small opening at the neck. (Figs. 3, 4 and 5.) Reconstructive operations were done forming a new urethra; because of necrosis we could not unite the canal with the bladder opening. The patient was content when lying down. Refused interposition.[1]

CASE 15. S. S., age 46, 8 children. Leakage had persisted after operation for cystocele. Six operations had been done pervious to admission. (1) Several small fistulæ were united by incision and sutured—flap splitting. (2) Construction of new urethra from vaginal flaps (Figs. 11 and 12) and suture to bladder. Repeated paraffine injections at bladder neck. (3) Closure of minute fistulæ at junction of canal of bladder and reefing of new urethra. Some continence with pressure pessary, (Figs. 9, 10, and 11).

CASE 16. See under "V. V. F. with destruction of sphincter." Case 3.

[1] After having been lost sight of for 1½ years this patient has just returned and desires further treatment. She is continent only when lying down.

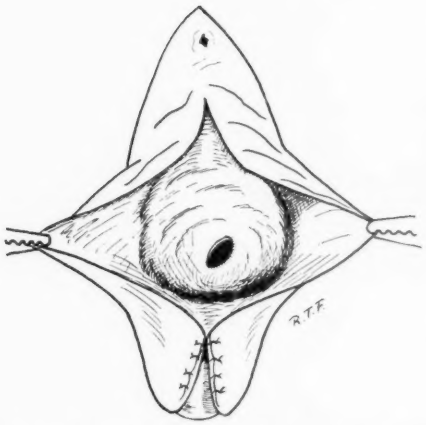

Fig. 3. Case 6. Vesicovaginal fistula; hæmatometra from cervical stenosis. Complete liberation of bladder, preceding repair of fistula. Incision of anterior lip of cervix in median line and plastic repair transposing external os upward.

Cases 17, 18 and 19. Although respectively due to childbirth, trauma (falling on fence picket), and slow development of incontinence at menopause, these cases were all healed by free mobilization of the bladder (in Cases 17 and 18 first repair of hole at vesical neck to size of No. 15 F), and union of sphincter fibers with three No. 1 chromic sutures. (Fig. 13.)

III. OPERATIONS IN VOGUE

The operations most highly recommended at the present day are: (1) denudation and suture according to the method of Sims; (2) flap-splitting with separate suture of bladder wall and vaginal mucosa; (3) suprapubic transperitoneal laparotomy.

All authors recommend the severing of those scars which fix the bladder to the pelvic bones. The usual method of approach is from the vagina. High and inaccessible openings may be attacked suprapubically, usually by the transperitoneal route, though occasionally the transvesical method has been advised. Kelly (loc. cit.) highly recommend opening of the peritoneal cavity from below in the treatment of fistulæ resulting from complete hysterectomy. The bladder becomes mobile as soon as the abdominal cavity is opened, because the intraperitoneal part of the bladder (base and fundus) can now be drawn down at will unless adhesions limit its mobility.

What follows is not to be interpreted as advice to discard either the Sims' operation or the flap-splitting method entirely, because in competent hands, both of these procedures have given excellent results. Furthermore, patients are encountered in whom an otherwise simple and accessible fistula is situated in a very scarry vagina. An attempt to close a small fistula by the above-mentioned simpler techniques may be justified under such conditions, in order to avoid the more extensive and difficult dissection necessitated by the bladder mobilization method. On the other hand, the mobilization method executed either from below, from above, or by the combined approach, requires less special training and offers more prospect of immediate cure in a single operation. The added risk to life, especially by the transperitoneal route, although not excessive, must be weighed in the balance. In complicated cases, however, the advantages of mobilization far outweigh any disadvantages or dangers which may be adduced against it.

Before describing the technique to be recommended, it is necessary to refer to the selection of the proper time for operation, preliminary treatment, etc., which are of great importance.

IV. PREPARATORY

Time of operation. As many fistulæ heal spontaneously, it is advisable to wait at least three months postpartum before interfering. This period is not wasted, as it allows the genital tract to involute completely, and gives the neighboring tissues, usually also involved, time to heal. Clean-cut, postoperative fistulæ, commonly due to unrecognized injury to the bladder, may be operated upon earlier than those resulting from sloughing or necrosis after operation. Usually 3 to 4 months must elapse before the exudate in infected cases has absorbed sufficiently to offer a promising operative field.

Preliminary preparation. The hair about the genitals should be kept closely clipped or shaven. Excoriations of the skin are healed by repeated application of thick zinc salve which is removed twice daily with olive oil. Raw encrusted areas on the vulva or in the

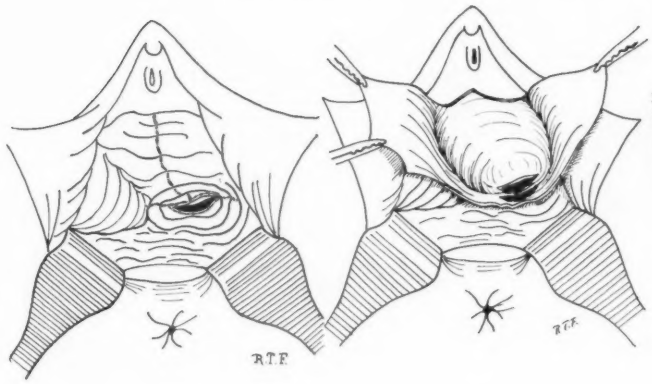

Fig. 4. Fig. 5.

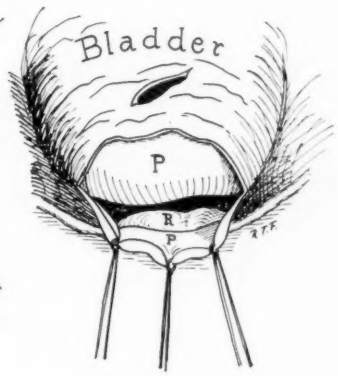

Fig. 6.

Fig. 4. Case 8. Vesicovaginal fistula resulting from radical operation for carcinoma of cervix. T-shaped incision through mucous membrane in dot and dash line.

Fig. 5. Case 8. Anterior surface of bladder exposed by reflecting vaginal flaps outlined in Fig. 4. The deeper and higher portion of the bladder remained adherent and immobile, fixed by the scar in the fornix.

Fig. 6. Case 8. Liberation of bladder base completed by opening the peritoneal cul-de-sac, thus permitting easy access and suture without tension. Compare with Fig. 5. *P*, Peritoneum, the upper part being peritoneum covering the bladder, the lower being the posterior peritoneum of Douglas' cul-de-sac, with traction sutures attached; *R*, rectum.

vagina should be touched up two to three times each week with five per cent silver nitrate. A hot sitz bath once a day is both soothing and cleansing. The urine should be kept acid by means of daily administration of four to six doses of acid sodium phosphate ($NaH_2P_2O_5$) gr. XV, and bacteria free by hexamethylinamine gr. V to VII, given three times daily. Bedridden patients may be made more comfortable if placed on a rubber ring, and supplied with a gutter of oil-cloth, which drains off the urine and keeps the bed dry. This is preferable to vulvar pads, which increase the local irritation.

Anæsthesia. Ether or gas-oxygen narcosis, except for minor interferences, facilitates good exposure and permits of more rapid operating.

Position. For vaginal work the usual dorsal lithotomy posture is most convenient. The knee-chest or Sims' position tends to increase the distance between the fistula and the vulvar orifice. Suprapubic operation requires extreme Trendelenburg position.

Armamentarium. Such vaginal retractors or spades as the individual operator is accustomed to, suffice for exposure. In addition to the usual instruments employed in vaginal plastic operations, the following are useful: Small curved and straight scissors, mouse-tooth and anatomical forceps, commonly used in intestinal suture, are of assistance, but are not indispensable. A bladder sound, soft rubber catheters, a Janet-Frank syringe of 100 to 150 cubic centimeter capacity, and small half curved needles should be ready. Occasionally, a Young's prostatic retractor or a small Voorhees bag will prove of service in dragging down the fistula. The suture material should consist of fine (No. 0 and No. 1 plain and chromic) catgut, and No. 2 twisted silk.

V. OPERATION

Although the principles underlying all operations are the same, the description will be simplified by describing in detail the technique as applied to the three main vatieties of fistulæ met with: (a) simple fistulæ (including vesicovaginal, vesicocervicovaginal and vesico-uterovaginal); (b) vesico-urethrovaginal (1) without, or (2) with complete destruction of the sphincter vesicæ; and (c) inaccessible fistulæ which necessitate suprapubic or combined vaginal and suprapubic approach.

Simple fistulæ. Exposure. After opening up the vagina with retractors the fistula should

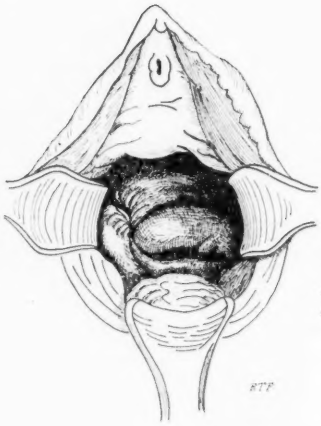

Fig. 7.

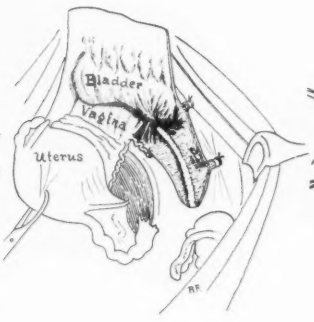

Fig. 8.

Fig. 9.

Fig. 7. Case 9. Inaccessible fistula above and to right of cervix partly exposed by deep retraction. The cervix could not be pulled down. The fistula was adherent to the left pelvic wall. Unsuccessful attempt at vaginal operation, completed by suprapubic operation as shown in Figs. 8 and 9.

Fig. 8. Case 9. Exposure of the neighborhood of the fistula shown in Fig. 7, by the suprapubic transperitoneal route. Both round ligaments and the right infundibulopelvic ligaments ligated and cut. Peritoneum widely reflected; right uterine artery ligated far laterally; right ureter exposed; bladder mobilized up to site of fistula.

Fig. 9. Case 9. Continued from Fig. 8. Complete hysterectomy to afford readier access. The left adnexa were not removed. The lower third of the right ureter was mobilized by sharp dissection; the right bladder angle was freed, permitting exposure of the vesical opening. Stump of vagina pulled on by traction sutures.

be brought plainly in view by pulling the cervix downward. If the vaginal canal is narrow and contracted, lateral incisions (single or double) through the perineum — as advised by Schuchard — increase the exposure. When the uterus is fixed, it may prove of assistance to pass two or more guide sutures at the edge of the fistula.

Incision. Instead of advising denudation of the edges or circumcision of the fistula with flap-splitting, the writer prefers a longitudinal or inverted T-shaped incision, such as is practiced in cystocele operation. Unless the fistula is excessively large, and thus greatly reduces the available amount of vaginal mucosa, the incision should be made in the median line, irrespective of the situation of the false opening. If a large fistula exists, less mucosa is sacrificed by making the incision Y-shaped, the arms of the Y corresponding to the edges of the defect (Fig. 14). The musoca should first be liberated in healthy tissue, and only as the edges of the fistula are approached, need special care be exercised. The vaginal flaps should be liberated as widely and completely as in the operation for vaginal interposition of the uterus. The liberation will usually prove easy, if the scar tissue is reserved for the last.

Liberation of bladder. The next step is the full liberation of the bladder. Here also the neighborhood of the fistula is left untouched until some other portion of the bladder has been freed. Care should be exercised not to enlarge the hole by rough manipulation. If difficulty is encountered in freeing the bladder from bands or from the pelvic bones to which it may be adherent, it proves of service to insert the index finger of the left hand into the bladder through the fistula (then enlarging the opening if necessary), and to sever adhesions under the guidance of the finger in the bladder. If the adherence to the cervix or uterus is embarassingly intimate, the liberating incisions can be made through cervical or uterine tissue until the scar area has been freed. The bladder must be as completely mobilized as is practiced in vaginal interposition (Figs. 3 and 13). As soon as the bladder is freed it contracts and can be readily ele-

vated. Only rarely will the ureters be encountered, except in those cases in which the fistula is situated far laterally in the fornix. If the field is well exposed, the ureters are readily avoided. In cases of this nature, it will often prove easier to operate by the combined method to be described below, rather than to grope blindly in an inaccessible and bloody cavity.

Suture. After the bladder is freed, all bleeding points should be carefully secured. Interrupted, Lembert-like sutures of fine chromic catgut passed through the muscular coat at one-half centimeter intervals are used to close the bladder defect, but no sutures are tied until all have been placed. The first and last suture should be passed one-half centimeter beyond the angles of the hole. When the destruction of adjacent structures has been slight, and fascial tissues are available (8), a further repair, such as is practiced in cystocele operation, may be employed. (Fig. 13, approximation by suture of the pubocervical ligaments *PC*.) The operation is completed by closure of the vaginal flaps with interrupted silk sutures.

In dealing with vesicocervical or vesicouterine fistulæ, openings in the cervix or uterus may be freshened and closed by suture as a final step, before the vaginal mucosa is approximated, or they may be left untreated, as they heal spontaneously.

The above operation can also be employed when the fistula has resulted from injury to the bladder during hysterectomy. The same method of exposures should be used. After exposure of the anterior part of the bladder, if the fistula is at or near the fornix (after complete hysterectomy), the peritoneal cavity should be widely opened at the fornix, as advised by Kelly (loc. cit.). This enables the operator to pull the posterior part of the bladder downward and forward. The sutures can now be passed without difficulty (Fig. 6). The peritoneal opening may be closed by a few sutures or may be drained by inserting a wick of iodoform gauze (to be removed after seven days), which should not come into contact with the line of suture.

Vesico-urethrovaginal fistulæ without complete destruction of the sphincter vesicæ. Unless

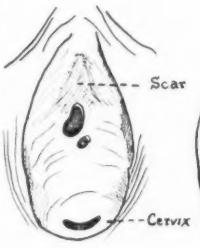

Fig. 10.

Fig. 11.

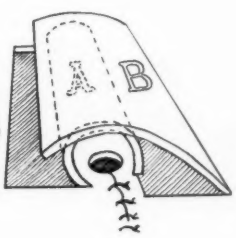

Fig. 12.

Fig. 10. Case 15. Complete destruction of urethra; two vesicovaginal fistulæ below area of scar.

Fig. 11. Case 15. Denudation and uniting of fistulæ outlined in dots. Vaginal flaps for reconstruction of urethra indicated in broken lines. The base of both flaps *A* and *B* are toward the patient's left.

Fig. 12. Case 15. Diagram showing the method of fixation employed on the liberated flaps outlined in Fig. 11. The fistulæ have been united and repaired except for a small opening left at the upper angle of the bladder injury. Flap *A* has been turned inward to form a tube lined with mucosa. Flap *B* is drawn across so as to cover not only the raw outer surface of flap *A*, but also to close in the vaginal defect left by reflecting *A*. At a later stage the new tube was united to the bladder opening.

the opening into the bladder is small and far anterior, it is preferable to liberate the bladder completely as in the preceding variety of cases, extending the incision well up toward the external meatus. In simple cases, the bladder and urethra are then sutured over a No. 12 or 15 French rubber catheter with interrupted sutures of chromic gut, which grasp the muscular but not the mucous coat. At the bladder neck the sphincter fibers together with a delicate but distinct fascia are then approximated by two or three interrupted sutures just as the sphincter ani is caught in the operation for complete tear of the perineum after the rectal defect has been repaired (Fig. 13). The torn and retracted sphincter of the bladder must be sought for close to the edges of the pubic rami. This region is very vascular, hæmostatic sutures often being required to stop the severe venous hæmorrhage.[1]

If the distal part of the urethra has been much mutilated or has entirely disappeared, little effort should be expended in restoring the urethral canal, because continence de-

[1] In searching for the fibers of a retracted vesical sphincter, it proves of service to pass a traction suture about 1 centimeter from the pubic ramus at the level of the neck of the bladder. When this guide is pulled upon, the stronger and deeper fibers are brought into view.

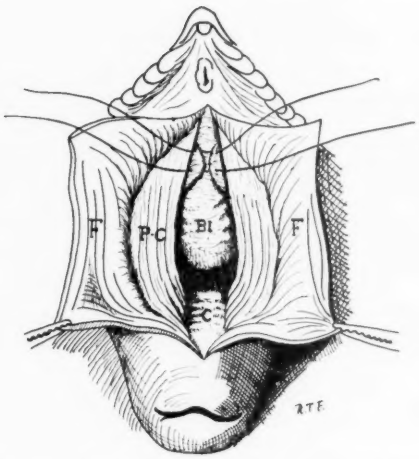

Fig. 13. Case 18. Exposure and suture of incompetent sphincter vesicæ. Vaginal flaps (*F*) have been liberated and retracted. The bladder (*B1*) has been freed and pushed upward, exposing the supravaginal part of the cervix (*C*). On each side the pubocervical ligaments (*P-C*) have been exposed. The sphincter fibers are shown partly approximated by traction on two untied sutures.

pends solely upon the sphincter fibers. Construction of a new canal greatly lengthens and complicates the operation with little more than cosmetic effect, even if union results.

Vesico-urethrovaginal fistulæ with complete destruction of the sphincter vesicæ. This fortunately rare variety usually is characterized by large defects and serious mutilation, with extreme distortion due to scar tissue formation. The entire base of the bladder has often disappeared together with the urethra. The upper, thickened, and inflamed wall of the bladder commonly prolapses through the hole. One or both ureteral openings may show along some part of the circumference of the defect.

The writer has never been fortunate enough to encounter such a case before it had been subjected to one or more previous operations.

In the three cases he has operated upon, all the tissues were almost hopelessly mutilated, perhaps more by the previous operations than by the primary injury.

In two of the cases, by repeated plastic operations, the bladder opening was reduced to a size just admitting a No. 15 F catheter. In the one (Case 15), a new urethra was constructed with vaginal mucosa flaps and at a later operation joined to the bladder opening. Continence wsa somewhat improved by submucous injections of hard paraffin around the neck. A pressure pessary (such as Kelly[1] describes) then served to give some control after the perineum had been repaired.

The second case (Case 14) was less successful, as every attempt at flap formation failed because of the invariable occurrence of necrosis. This patient refused to consent to vaginal interposition, as she desired to have a child before being sterilized.

The third case (Case 16) resulting from pubiotomy, with an extensive defect and much operative loss of tissue was treated in the following manner. By repeated operations the bladder was freed from the pubic bones, the opening being reduced to small size. After this reduction had been accomplished, a bladder sound, passed through the opening, was then forced outward toward the skin above the region formerly occupied by the clitoris. The skin was incised and the bladder wall (drawn out into funnel shape) was sutured to the skin. Later the old bladder opening in the vagina was completely closed. A belt with pad applied over the new urethra gives some degree of continence but proved too irksome for the patient to wear. Further operation may improve the control. (Figs. 14, 15, 16, 17.)

These three operations were planned in the hope of utilizing a new formed urethra to give some degree of control. On the whole the results were as disappointing as those described by other operators. In the future the writer proposes to use in modified form a procedure which has been previously employed by Freund (9) and others to close large defects by means of the interposed uterus. In the present instance the uterus is to be employed not to close the gap, but to take the place of a pressure pessary in re-establishing continence.

The operation may be executed in the following sequence: (a) liberation of the bladder; (b) transposition of the uterus through the anterior cul-de-sac — (1) *per vaginam;* or if this fails (2) by the suprapubic route; (c) closure of the bladder defect down to a small opening which is to functionate as the urethra; (d) interposition of the fundus uteri into the vesicovaginal space.

The operation should be limited to desolate cases with large defects, and especially to

[1] Kelly and Noble. Gynecology and Abdominal Surgery, 1907, vol. i, 502.

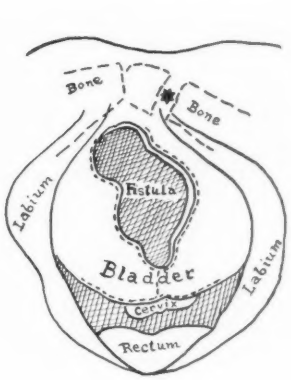

Fig. 14.

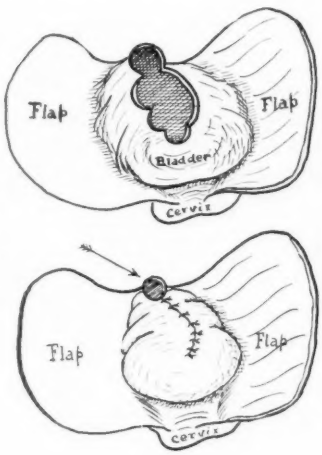

Fig. 15.
Fig. 16.

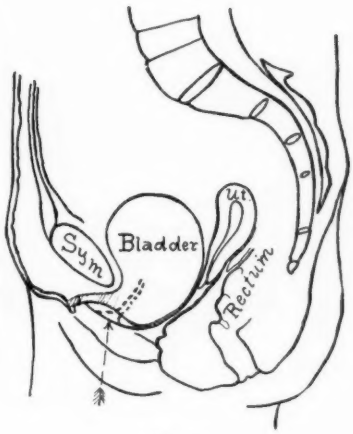

Fig. 17.

Fig. 14. Case 16. Diagram of enormous vesicovaginal fistula with destruction of sphincter and urethra after pubiotomy. Asterisk shows space between ununited ends of ramus. Outline of incision indicated in broken lines.

Fig. 15. Case 16. Diagram showing liberation of bladder after reflection of vaginal flaps illustrated in Fig. 14.

Fig. 16. Case 16. Diagram showing suture of fistula except at its upper angle (arrow). (See Figs. 14 and 15.)

Fig. 17. Case 16. Diagrammatic sagittal section showing formation of new urethra above the region of the clitoris. New canal in shaded portion; situation of a normal urethra indicated by broken lines. Arrow head at site of opening seen in Fig. 16. This opening was closed after the patency of the new canal had been assured.

cases in which the entire sphincter apparatus has been destroyed. It should be the operation of choice and take the place of complicated plastic repairs, which even if they prove anatomically successful, fail to restore continence.

Operation. Liberation of bladder. The vaginal mucous membrane should be separated from the bladder along the edges of the defect, the incision extending downward toward the cervix (forming the base of a Y). With one finger in the bladder, the liberation of this viscus should be attempted, preferably beginning the separation in the least adherent portions. It usually becomes necessary to detach the bladder from one or both rami to which it has become adherent. The hæmorrhage is profuse and persistent. As the bleeding spots are located in dense scar tissue, hæmostatic sutures are usually required.

Transposition of the uterus. If the anterior peritoneal reflection can be reached and opened, an attempt should be made to draw the uterus into the vagina. Should this effort be successful, the operation is completed by narrowing the bladder defect by means of suture down to a small opening just admitting a No. 15 F. catheter. The uterus is then interposed between bladder and vagina, so that the top of the fundus projects to or beyond the new opening. The vaginal flaps are sutured over the uterus, lateral openings for drainage gauze being established between uterus and vaginal flap. The tubes must of course be ligated.

Transposition of the uterus by the suprapubic route. If it is impossible to reach to peritoneal reflection, if the liberation of the lateral parts of the bladder fails because of too dense adhesions and scar, or if the hæmorrhage proves uncontrollable, the vagina should be tightly packed with gauze and the abdomen opened suprapubically. In steep Trendelenburg position, the uterus is drawn upward and the vesico-uterine peritoneal fold widely opened. The round ligaments may be cut between ligatures to give freer

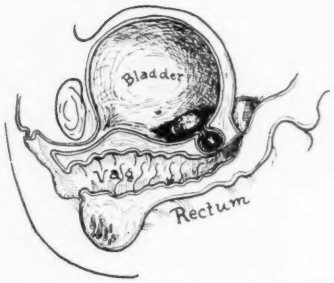

Fig. 18. Case 5. Sagittal section showing "collar button" stone projecting partly in the bladder, partly hidden in a diverticulum resulting from closure of a vesicovaginal fistula.

Fig. 19. Photograph of stone shown in preceding figure.

exposure. The bladder can now be freed more readily. At times it may prove necessary to doubly ligate and cut one or both uterine arteries in order to liberate the ureters and bladder angles. All hæmorrhage is now controlled by ligature or suture.[1]

After removing the vaginal packings, the uterus (first ligating the tubes) is pushed down into the vagina, the incision in the vesico-uterine peritoneum is sutured, and the abdominal wound closed. The operation is completed from below in the manner outlined in the previous paragraph. This type of operation is, of course, as previously stated, to be strictly reserved for the severest cases in which no muscle tissue remains at the neck of the bladder. The operation is long and severe.

Should the desired degree of control not be obtained, added pressure may be exerted upon the uterine pelotte by subsequently narrowing the vagina and increasing the height of the perineum.

Inaccessible fistulæ. In some cases the fistula is situated so high, the scar formation is so dense, or the bladder is so adherent, that it proves impossible to reach the defect *per vaginam.* In other instances uncontrollable hæmorrhage is encountered.

Under these circumstances it is preferable to attack the trouble through a median suprapubic incision. An effort may be made to preserve the uterus, proceeding, as previously described, by incising the vesico-uterine fold of peritoneum. The bladder is then freely mobilized, the hæmorrhage controlled and the fistula repaired by suture. If the technical difficulties are insurmountable, complete hysterectomy, with or without removal of the appendages, affords added facility in the liberation of the bladder. When the fistula has been exposed and the bladder fully liberated, gauze for drainage should be drawn into the vagina *before the bladder is sutured* (in order to avoid disturbing the line of suture later). The gauze should not touch the line of suture. The bladder hole is closed with a few interrupted sutures of fine chromic gut. The pelvic peritoneum is then closed, so as to extraperitonealize the field of operation. The sigmoid may be attached over the suture line as an additional safeguard. The abdominal wound is closed without drainage. (Figs. 8 and 9.)

[1] In one instance of suprapubic operation, the bleeding from thin-walled parametrial veins could not be controlled by any means except by tightly sewing several layers of gauze to the bleeding area. One end of the gauze was drawn out through the vagina and the pack readily removed on the eighth day.

VI. AFTER-TREATMENT

Permanent catheter. A light weight rubber catheter should be inserted into the bladder and fastened to the meatus by a suture, reinforced by adhesive plaster. The catheter drains off the urine and *keeps the bladder in a permanent state of contraction* for at least 8 days. The receiving vessel should be graduated so that any stoppage of flow is at once noted and corrected. It is the writer's practice to instruct the patient to watch the flow and to inform the nurse as soon as an

obstruction occurs. By slightly pulling the catheter outward or pushing it inward, the stoppage is usually overcome. If clots or clumps of mucus cause obstruction, introduction of ½ to 1 ounce of sterile solution by means of a syringe will clear the line.

The bowels should be kept constipated for 5 to 8 days. Early straining at stool may reopen a fistula.

Leakage. Should leakage of urine through the vagina be noted, the operation is not necessarily unsuccessful, especially in those cases in which the bladder has been freely mobilized. The permanent catheter should be kept in place for at least 14 days, as healing may yet take place. In one instance, (Case 9) this measure was crowned by success after 28 days.

Coitus should be interdicted for at least 8 weeks. One patient (Case 2) on the fifteenth day left the hospital cured. She returned two days later the fistula having reopened as the result of coitus. A second operation had to be performed.

VII. DIVERTICULA AND STONE FORMATION

In three cases (Cases 4, 5, and 7) all postoperative in origin, the fistula, because of the distortion due to scar formation had produced narrow funnel-shaped diverticula of the bladder. These were unrecognized at the time of operation because the flap-splitting method of repair was employed. In Case 7, the first operation was unsuccessful, the leakage persisting. At the second attempt at closure, the bladder was fully liberated, the diverticulum was exposed, recognized, and excised, and the defect sutured. She has remained well (3 years).

In the two others (Case 4 and 5) healing took place, but repeated formation of soft vesical calculi occurred. These at once re-formed after removal through a Kelly cystoscope. Search for an encrusted suture proved negative, cauterization of the granulating area after removal of the stones was unavailing.

In the first case an incision into the vesicovaginal septum revealed a collarbutton-shaped stone, the smaller portion being embedded in the extravesical diverticulum, the head projecting into the bladder, a narrow isthmus connecting the two enlargements. the diverticulum was thoroughly cauterized with pure carbolic acid, as excision was impossible. An intractable cystitis complicated the condition, and later necessitated vaginal cystotomy with drainage (Figs. 18, 19) for removal of the intravesical stone and treatment of the cystitis.

In the second case a permanent cure has not yet been affected, because the vesical calculus was removed just before operation, and therefore, the sole guide to the small diverticulum was lost. Exploration of the vesicovaginal septum failed to reveal the diverticulum. As soon as the stone has re-formed, another operation will be undertaken with the attached stone *in situ*.[1]

VIII. CLOSURE OF MINUTE FISTULÆ

The closure of very small fistulæ sometimes give as much or more trouble than the repair of large defects. The writer succeeded in closing a small opening, which persisted after the closure of a large hole, and which did not heal. The method employed was the following: The bladder was kept distended by means of a continuous current of water introduced through one channel of a catheterizing cystoscope. Through the other channel a wire insulated except at its tip was passed for a short distance into the intravesical opening of the fistula. The d'Arsonval current was applied for 10 seconds as recommended by Beer (10) for bladder papillomata. The fistula has remained permanently cured.

IX. SUMMARY

Comparison of those cases of bladder injury which heal spontaneously with those which form permanent fistulæ shows, that neither the size nor situation of the defect is of as much importance as the fact that in the former the bladder is free to contract and that broad tissue planes are mobilized.

By applying these observations to operative repair, more uniformly successful results may be anticipated.

Full liberation of the bladder should be practiced in every case before attempting to repair the injury. This injunction should be obeyed especially by the occasional operator

[1] Since the completion of this paper, this patient has also been operated upon. A suprapubic cystotomy was performed, the intravesical portion of the stone removed, and the diverticular b-ilobed part of the stone liberated by incising from about ½ centimeter behind the internal sphincter backward between the ureteral openings for a distance of 2½ centimeters. The stone was dislocated into the bladder. As the diverticulum could not be excised because it was in intimate contact with the rectum and stump of the vagina, the posterior bladder incision was sutured in such a fashion as to make the opening large and give it free communication with the bladder. This case will be published *in extenso* at a later date.

who is not intimately acquainted with the minute and precise technique of the Sims and the flap-splitting operation.

With slight variations, the above method of procedure is applicable alike to simple fistulæ (vesicovaginal, vesicocervical, vesicourethrovaginal), inaccessible fistulæ, and fistulæ complicated by partial or complete destruction of the bladder sphincter.

When the bladder sphincter is completely destroyed, plastic construction of a new urethra proves unsatisfactory. After repair of the defect the uterus may be interposed into the vesicovaginal septum to restore continence.

Depending upon the local conditions encountered, the vaginal, suprapubic, or combined method of approach may be practiced.

When a leak develops, the use of the permanent catheter should be persisted in, far longer than is customary, as healing may still take place as late as the fourth week.

By fully liberating the bladder as a matter of routine, diverticula (which later may cause stone formation) cannot escape notice. The closure of minute fistulæ may be attempted by intravesical cauterization with the d'Arsonval current through a water cystoscope.

X. CONCLUSIONS

1. Spontaneous healing of vesical injuries takes place most readily when the bladder is fully mobilized, and the tissue planes are given an opportunity to glide one upon another.

2. The process of spontaneous repair is assisted by keeping the bladder in a state of contraction by means of a permanent catheter.

3. Bladder suture is of secondary importance, if the above principles are utilized in operative intervention.

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THE SURGICAL SIGNIFICANCE OF THE CYSTICODUODENAL AND THE CYSTICOCOLIC LIGAMENTS[1]

By WELLER VAN HOOK, A.B., M.D., Chicago

THE purpose of this paper is to direct attention to the surgical importance of those variants of portions of the great hepaticogastric ligament which take origin in the gall-bladder and, in the one case, pass to the duodenum and, in the other case, run over to the colon.

Permit me to present quite briefly, the two observations forming the basis of the paper.

Case 1. A strong man about 25 years of age, in good health except that he had had several attacks of acute cholecystitis with the colic that is usually associated with temporary, partial obstruction, applied for surgical treatment.

An operation was undertaken a short time after an acute attack. The temperature had been normal for several days, the tenderness was slight and there was no pain, the patient being able to go alone to the hospital from his out-of-town home.

On opening the abdomen the gall-bladder was found at the usual site and there were no adhesions about it at any point. But it was found to be attached to the colon by a fold of peritoneum, a perfect example of *ligamentum cysticocolicum*.

This ligament extended from a point upon the gall-bladder about one-third the length of the gall-bladder from the apex of the sac downward to involve the lower part of the receptacle and the cystic duct. It passed over in an easy fold to be inserted into the colon wall, joining with the mesocolon and spreading out upon the bowel itself. The tissue of the ligament was not infiltrated, showed no signs of inflammatory origin or attack. On the contrary it was as flexible and as easily torn as, let us say, the meso of the vermiform appendix.

Upon opening the gall-bladder with extreme care as to protection of the abdomen from gall-bladder contents a few drachms of bile, a little thicker and darker than usual, were evacuated. This fluid showed no signs of purulent or serous admixture and contained no flocculi or detritus. There were no stones and the cystic duct was found by the probe to be quite patent. As the patient was not fleshy the common duct could be palpated, together with the accompanying structures, but no stones served to differentiate it by palpation.

The walls of the gall-bladder showed no sign of inflammation, past or present, other than a rather deep reddening of the mucosa.

The influence of this ligament on the patient's health seemed manifest when the gall-bladder was

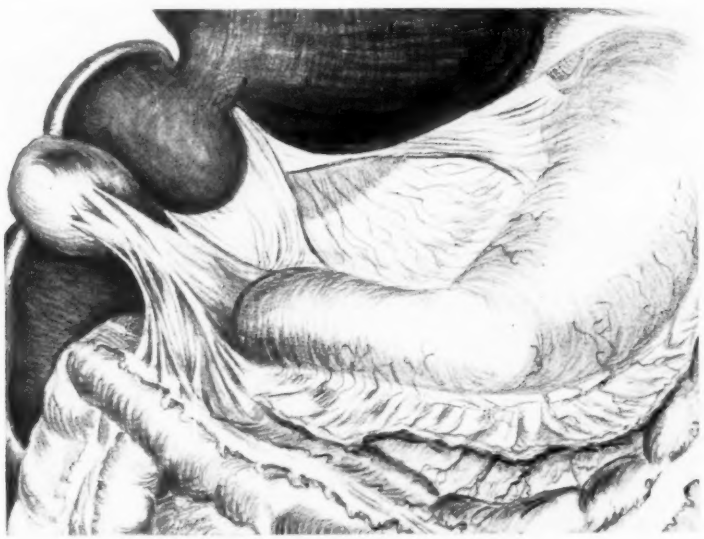

Fig. 1. Ligamentum cysticocolicum. Case 1.

[1]Read before the Chicago Surgical Society, January, 1917. (For discussion see p. 571.)

Fig. 2. Ligamentum cysticoduodenale. Case 2.

raised with the liver and the colon was drawn downward, for this maneuver demonstrated that distention or ptosis of the colon drew the gall-bladder sharply downward in such a way that angulation of the cystic duct could easily occur. The ligament was divided, partly with the fingers and partly with the scissors, the small blood-vessels being ligated. Careful drainage of the gall-bladder with a rubber tube and of the neighboring peritoneum with gauze was followed by closure in the usual manner. Not the slightest technical difficulty was encountered to suggest an unhappy outcome of the operation. Nevertheless peritonitis of the swiftest kind set in and the patient died in about thirty-six hours.

A limited *postmortem* examination was made by Dr. Walter Stranberg who reported that a violent peritonitis with but little fluid exudate was responsible for the termination of the case; that there was no blood or any foreign body in the abdomen and that no injury or rupture of any viscus other than the operative wound already spoken of could be found. It was concluded that the fatal termination was due to an infection of the peritoneum at the site of the wound in the gall-bladder, which doubtless was the source of the extraordinarily virulent bacteria.

The opportunity to make the full inspection of the upper abdomen showed that there was present no other cause for the obstruction of the gall-bladder than the angulation due to the traction upon that structure by the colon, which was attached to it by the unusual cysticocolic ligament.

Case 2. Mr. W., aged about 45 years, had suffered for several years from recurring attacks of gall-bladder colic and inflammation. These attacks were moderately severe lasting a few hours and were associated with a slight elevation of temperature. Tenderness, greatest when the distended and palpable gall-bladder was blocked during an attack, persisted throughout the interval between exacerbations. The diagnosis of gall-stones was tenaciously maintained by the very skilled attending physician.

On inspecting the gall-bladder and the surrounding structures, some light adhesions were observed between the lower part of the body of the gall-bladder and the duodenum. Their presence was interpreted as testimonial to the diagnosis of chronic and recurring gall-bladder inflammation.

Attention was then directed to another structure uniting the gall-bladder to the duodenum. This structure was a true cysticoduodenal ligament.

It took its origin upon that face of the gall-bladder wall that looks toward the pylorus and, as the gall-bladder was held up, it descended in an easy curve to a broad insertion over the duodenum, extending about half-way around the circumference of that organ.

This fold was composed of two plates of peritoneum with a filamentous layer of loose and slightly fat-laden connective-tissue between them. It was divided partly by tearing and partly by cuts with the scissors. It was carefully noted that at no point was there evidence of an inflammatory element in the production of this structure; there were no contracted or tough band-like elements of fibrous tissue. Nor was there any unyielding element in the ligament; but, as the tissue was pulled upon,

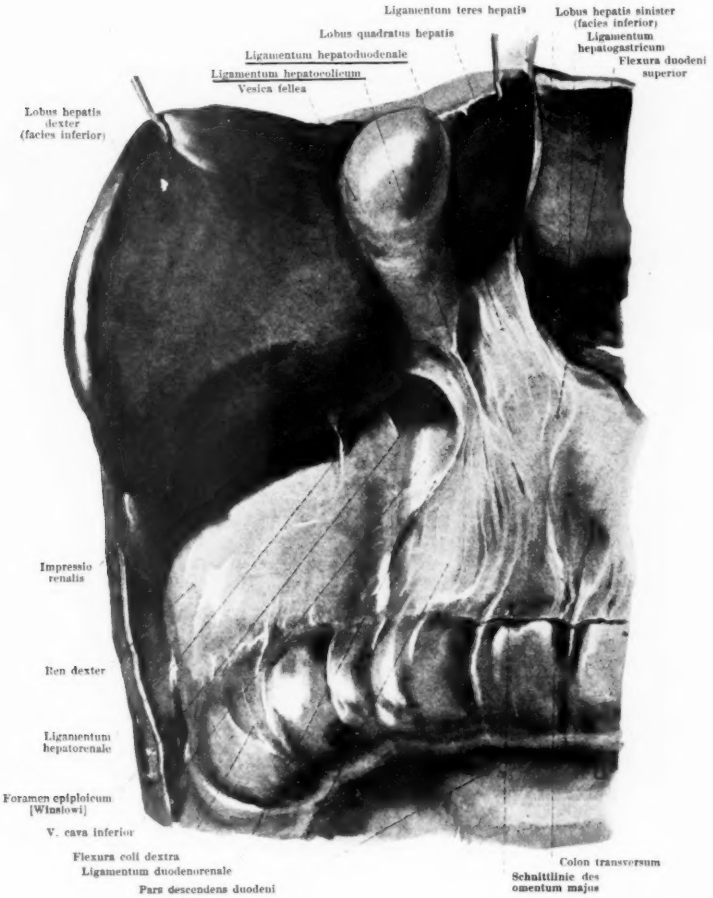

Fig. 3. Usual arrangement of ligaments. (From Spalteholz.)

it gave way by successive, regular ruptures of the stretched, normal connective-tissue. The conclusion was irresistible that we had to deal with that uncommon variant portion of the hepatoduodenal ligament known as the cysticoduodenal ligament. On opening the gall-bladder no stones were found; but the bile was rather thick and almost black. The wall of the gall-bladder was not grossly altered. No bacteriological examination was made.

As there were no stones and as the ligament described must have been present *ab origine* it was concluded that its influence in holding the body of the gall-bladder in approximation to the duodenum must have been the determining factor in producing the cholecystitis by bringing about angulation at the cystic duct. This conclusion is strengthened by the fact that all symptoms of cholecystitis disappeared after the division of slight adhesions and of this ligament. Drainage of the gall-bladder was maintained for a number of weeks.

On looking over the multiplicitous pictures provided by the anatomists in illustration of the bile-passages, a plate was found in the

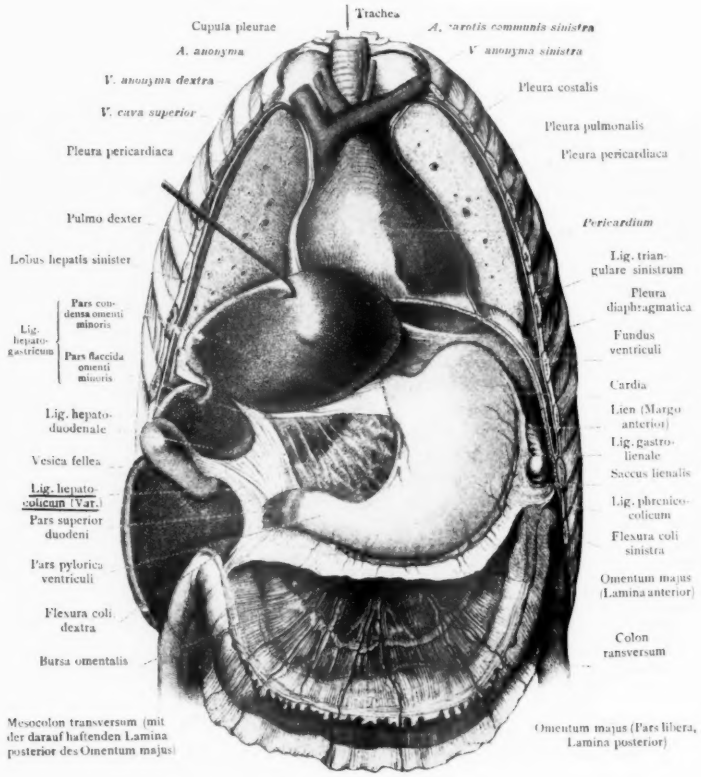

Fig. 4. Note the well-marked ligamentum hepatocolicum. (From Toldt.)

classical atlas of Toldt showing clearly an example of one of these ligaments. Then the study of Poirier yielded the following exact description:

In certain rare cases the gall-bladder is entirely suspended from the liver by a peritoneal fold of ligament (*mesocyste*, Fr.) and enjoys a wide mobility; distention partly effaces the meso while augmenting the surface of contact with the liver.

The relations of the anterior face (of the gall-bladder) are, in front with the transverse colon, in the rear with the duodenum, organs to which it may be united by accidental adhesions or even by a peritoneal meso, the *cysticocolic* ligament.

Sometimes indeed the gall-bladder and the transverse colon are contained in a peritoneal meso, called the *cysticocolic ligament*. This ligament, which is but a variety of the hepatoduodenal ligament, that is to say of the dextral part of the gastro-hepatic ligament, is inserted above upon the lower face of the gall-bladder from the neck as far as the beginning of the fundus and descends below upon the anterior face of the duodenum and the dextral angle of the colon. The lower face of the gall-bladder, then, finds itself deprived of peritoneum up to the vicinity of its borders and is separated from the colon solely by cellular tissue. The ligamentum cysticocolicum is met with once in four cases according to Briçon and Jonnesco; once in seven times according to Raynal. In some exceptional cases observed by the preceding authors it coincided with (was equivalent to) a cystic mesentery (meso-cyste) inasmuch as the gall-bladder was suspended in the midst of an hepaticocolic ligament.

Hans Kehr presents, incidentally, a picture of one of these ligaments although I am not aware that he attributes to the structure any rôle in the causation of disease.

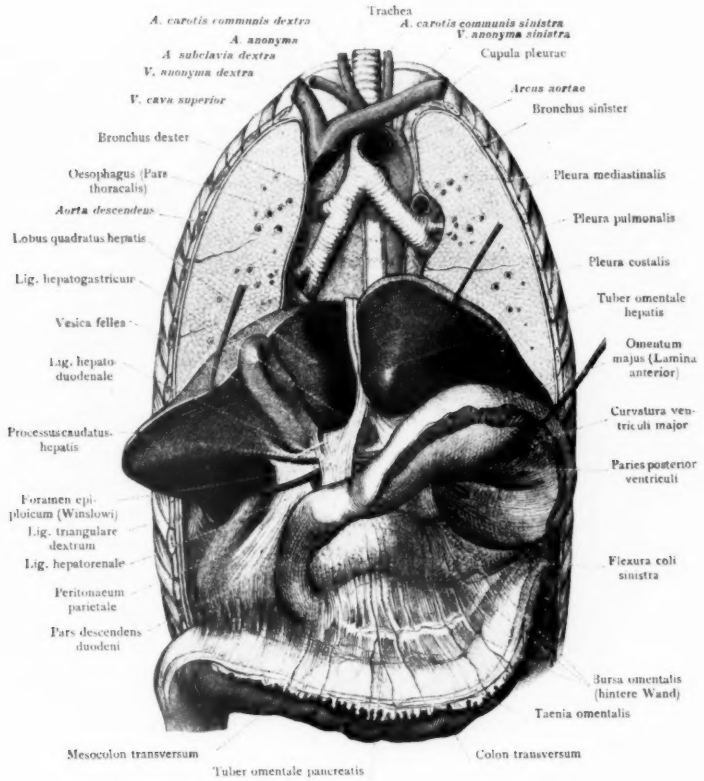

Fig. 5. The usual arrangement of ligaments. (From Toldt.)

It has been the custom to speak of such hollow organs as the kidney, the urinary and gall-bladders and the pancreatic and salivary glands as being provided with the mechanism and the conditions for drainage. Yet the word drainage presents only a part of the full notion of what actually occurs. For the walls of these organs and of their excretory ducts have muscular layers that actively expel the fluids that come into existence within them.

Yet even with the positive aid of the musculature, great difficulties in the functioning of the structures considered take place when mechanical interference with the tubage occurs. Thus, as every pathologist knows, the least blocking of a duct favors the localization of infection above the point of obstruction.

Now for the gall-bladder, stones may or may not be merely incidental to the occurrence of the partial obstruction. In all cases of cholecystitis the element of incomplete emptying of the gall-bladder ought to be considered by the surgeon even if the obstruction be but partial.

Without entering exhaustively into the subject of the causes of incomplete emptying of the gall-bladder, it may be said that the causes are *intrinsic* and *extrinsic*.

In the former category are to be included the diseases of the gall-bladder wall, such as paralysis, cicatrization, and malignant growths, together with the internal obstruc-

tions due to the action of stones, scars, and valves. In the latter category are to be found the obstructions caused by compression or constriction, and by angulation.

Now it is with one phase of angulation of the bile-ducts that we are especially concerned. With the angulations caused by inflammatory or malignant action we have nothing to do. And similarly, we must say but little of those angulations that are caused by the unusual relations that may subsist between the ducts and the hepatic artery.

The normal angle formed by the gall-bladder with the longitudinal axis of the body is pronounced. Poirier calls attention to the fact that the gall-bladder has too frequently been supposed to point as it were, straight forward, whereas the body of the sac is well to the right of its outlet. When the gall-bladder is fixed by adhesions too far to the right, there may be partial obstruction.

While it seems probable that under ordinary conditions the emptying of the gall-bladder may be compromised in no degree by the presence of a ligamentum cysticoduodenale or a ligamentum cysticocolicum, yet when there is displacement of the colon or duodenum the ligament may cause angulation of the duct by traction. Intermittent angulation may easily occur by the overfilling of the colon with gas. Practically the same thoughts are valid with reference to the ligamentum cysticoduodenale.

It is obvious that, as in the instances here reported, this angulation may cause localization of bacteria in the gall-bladder with the classical symptoms of cholecystitis.

It is to be hoped that other surgeons will contribute observations upon these important structures, of which the rôle in surgery may prove to be of as much importance as the peritoneal bands and folds now so frequently noted as being discovered in the ileocæcal region.

DEPARTMENT OF TECHNIQUE

WIRE-BANDING FOR FRACTURES

With the Description of a New Tool

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AND
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THE wire-banding method which we are about to describe is a scheme to avoid the disadvantages of the Parham band. Mr. Robert Milne, devised the first fracture banding mechanism which could be called efficient.

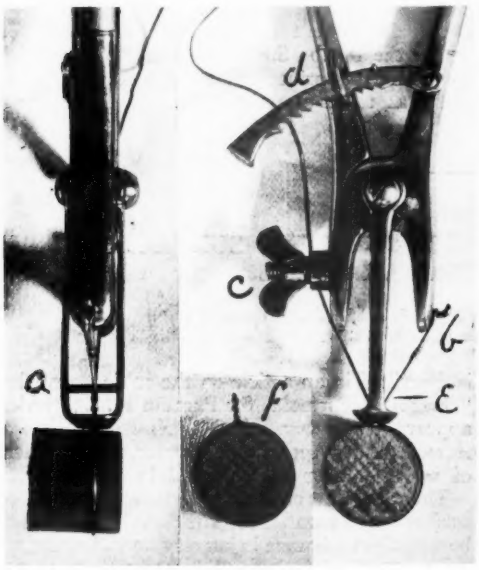

Fig. 1. The strand of wire used has a loop (brazed) at one end. The wire is passed about the bone, and the ends passed, crosswise through the oval, smooth edged hole in the tip, then up on either side the cross-bar (*a*). The looped-end then goes over the hook (*b*), the free end is clamped by a camlock under the wing-nut (*c*). The handles are then closed until the wire is fairly snug. The tension is held by the ratchet (*d*). Then the whole instrument is twisted: the smooth hole in the tip makes the spiral close and the cross-bar (*a*) crowds the turns down close. The wires are cut at the level of (*e*). The loop is flattened over onto the bone. How close the wire-band is drawn may be seen from the insert at (*f*).

Parham, of New Orleans, went much further; we have used the Parham band in many cases with great satisfaction. It has the disadvantage, however, of leaving in the tissues too much foreign material, and of creating a point of least resistance in the bone, even if the band is imbedded, as we have found it to be in the majority of the cases examined some months or years later.[1]

One case, banded ten months ago by one of us, illustrates this finding clearly (see Fig. 1).

It seems reasonable to follow the rule that all bands should come out after union has taken

[1] In one case of Dr. William E. Faulkner, the band was not imbedded bu showed a girdling groove in the bone and a diameter within this groove definitely less than that of the rapidly growing child's femur.

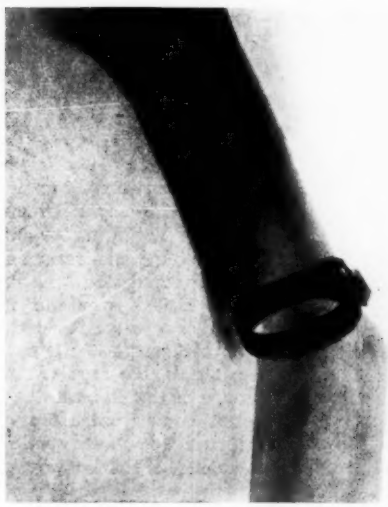

Fig. 2. Femur banded ten months previously. Refractured exactly at point of banding by fresh but slight accident. The band is clearly shown to have been imbedded, but it nevertheless constituted a point of least resistance.

place, and we have recently adopted this rule in handling fracture cases. However, if a second operation to remove the band can be eliminated, if we can overcome the disadvantage of irritation and possible non-union by using a negligible bulk of metal — just a band of thin, strong wire — the gain is obvious.

The use of wire is not new, but the methods used have been found mechanically inefficient. The hose manufacturers and the packers and balers of various goods (from hay to old newspapers) have used wire-banding instruments. The instrument which came nearest to meeting our needs was the wire-twister used to fasten rubber hose to metal ends and joints. While this instrument most effectively answers the purpose for which it was designed, it has proved inadequate for wiring fractures; for such a twister leaves a V below the twist that impairs the fixation of rigid objects.

Our problem, therefore, was, first, to eliminate the V, and second, to secure tension without snapping the wire, and we have succeeded in making a twister which fulfills both requirements. The instrument shown will twist wire down *flat* to the bone surface. The wire can be twisted one and one-half turns after reaching the point of actual fixation.

We use phosphor-bronze wire, silvered (although that is probably entirely unnecessary), of gauge 18 to 20, Brown & Sharpe.

One wire does the work of a Parham band in most cases. Two wires will do more than any Parham band possibly can, and will leave an incomparably smaller cross section of metal about the bone.

Although the method has been used clinically in a few cases, it cannot be said to have been proved out clinically, as yet. It has worked well so far.

Its application as a substitute for the Parham band is fully justified.

Just how much can be done in the fixation of fractures by wire passed through drill holes and brought taut by this instrument, is still an open question, although it has worked well on the few cases in which we have used it.

The instrument devised has been presented before the Boston Surgical Society, and we wish to present it in print so that others may use it and judge as to its practicability.

THE TREATMENT OF BURNS AND GRANULATING SURFACES WITH PARAFFIN-FILM PREPARATIONS

By ELWOOD B. HAWORTH, M.D. F.A.C.S., Pittsburgh
Surgeon Western Pennsylvania Hospital

THE wax or paraffin-film treatment of burns and granulating wounds sprang from the sensational accounts of the secret French preparation "ambrine" much used in the war now going on. American surgeons returning from the war in France have given glowing accounts of the wonderful results from the use of ambrine. This led to two or three American products being placed on the market. All have followed the French example of keeping the formula a secret. It is one of the disadvantages of secrecy that we do not know what attempts have been made to secure the best possible preparation; and in the absence of this knowledge, it is reasonable to suppose that the secret preparation is capable of modifications which might add to its improvement.

To meet the demand for a non-secret ethical preparation, quite an investigation of the subject has been made by Dr. Torald Sollman which is described in an article on the subject, entitled "Suggested Formulas for Paraffin Films," which appears in the *Journal of the American Medical Association* for April 7, of this year, some extracts of which I have incorporated in this paper.

The treatment of burns and granulating wound surfaces with paraffin preparations has proved to be a distinct advance in surgery and any surgeon who has employed this method of treatment cannot but realize that the results obtained are much superior to those obtained by any other procedure.

Wounds cicatrize in one-third to one-half the time. The scar tissue is less dense and more flexible, and skin grafting is comparatively not often required. Should skin grafting be thought advisable it will be found that, under the paraffin-film application, these grafts will develop much more rapidly than by any other known method.

The action of the paraffin-film application

upon granulations is largely mechanical. On cooling, the film contracts and exerts a suction action, thus inducing an active hyperæmia. By keeping the wound airtight, and by acting as a splint or scaffolding to the granulations, it promotes active proliferation of the newly formed tissue cells.

Many formulas or combinations of paraffin with other substances have been suggested and used in this country as well as abroad. All the preparations, including ambrine, have paraffin as a base and Dr. Sollman in his experiments with paraffin mixtures used 28 different ingredients including petrolatum, Venice turpentine, Japan wax, olive oil, yellow beeswax, castor oil, spermaceti, resin, cocoa butter, liquid paraffin, and the different varieties of asphalt. As compared with ambrine (which he states contains 96 per cent of paraffin) he could note no marked differences as between any of the above combinations. The different varieties of paraffin on the market have melting points varying from 48° to 53° C. and the various commercial brands differ in their physical properties, such as melting point, hardness, and flexibility. It was found that samples melting close to 50°C. are to be preferred. Aside from melting point, flexibility seems to be one of the most important features.

Most paraffins found on the market are too hard to use without incorporating some softer substance to modify and make them more flexible. The admixture of wax and resin with paraffin seems to modify it suitably for the purpose of a film dressing and Dr. Max Kahn, biochemist of the Western Pennsylvania Hospital, has suggested that 2 or 3 per cent of paraffin oil added to melted paraffin renders it much softer and much less liable to crumble upon cooling.

Dr. A. J. Hull, of the Royal Army Medical Corps, states that treating paraffin with superheated steam seems to change its character in that it becomes softer and more flexible. He also states that the results attained with its use as a dressing in burns seem indistinguishable from those of ambrine. He further states that even better results are obtained by the addition of certain antiseptics and stimulating substances. The wounds become clean more rapidly, pain decreases, and the offensive smell associated with ambrine dressings is avoided. The formula we first began using at the Western Pennsylvania Hospital was composed of 70 per cent of Gulf wax paraffin, 20 per cent of white beeswax (U. S. P.), and 10 per cent of resin.

With this product we could obtain all the effects of ambrine, but it was not so flexible and had a marked tendency to crumble. To obviate this, Dr. Kahn suggested adding 2 per cent of Russian mineral oil to the formula. Further experiments showed that the addition of a small quantity of resorcin seemed to obviate the offensive smell before referred to as following the use of ambrine.

It was then thought that the addition of some substance to the formula to promote the more rapid proliferation of the epithelial cells would prove a benefit. We have used two substances for this purpose: scarlet red and sudan III, suggested by Dr. Kahn. Sudan III seems preferable as its action as a stimulant of epithelialization is found to be more pronounced. Sudan III is a diazo compound of the aniline series, having the composition C^{22} H^{16} N^4 O. It is soluble in alcohol, chloroform, xylol, and essential oils.

Upon the injection of certain dyes like sudan III, or scarlet red, pathologists have observed a certain stimulation in the proliferation of epithelium. This active proliferation has been ascribed by Fischer to an attraction for the epithelial cells. He called the dye, therefore, an "attraxin." The changes are primarily in the connective tissue and resemble the changes produced by chronic inflammation. When sudan III or scarlet red is injected immediately below the epithelium, the connective tissue first loses its reaction to acid dyes. Following this the epithelium begins to proliferate. The epithelial proliferation is confined to the area in which the connective tissue has undergone its modified reaction to acid dyes. The epithelium retains its normal characters, but the mitotic figures may be observed and pearl formation is common. The epithelium does not invade regions where preliminary changes in connective tissue have not occurred. The results obtained by sudan III administration are similar to the effects produced by X-rays, except that in the latter instance the epithelial cells have a tendency to invade (after a time) regions where the tissue is still normal, and thus metastases may be formed as in all malignant neoplasms (Wohlbach, Hertzler).

The formula of the wax preparation we have been using at the Western Pennsylvania Hospital for the last four or five months and from which we have attained most excellent results consists as follows:

Paraffin (Gulf Refining Co., Pittsburgh)	70.0	gm.
Liquid petrolatum, U. S. P. (paraffin oil)	3.0	ccm.
White beeswax, U. S. P.	10.0	gm.
Resin	7.0	gm.
Resorcin	0.2	gm.
Sudan III	0.05	gm.
Alcohol (95 per cent)	10.0	ccm.

The paraffin and the oil are melted in a casserole over asbestos board, the direct fire being used. The resorcin and sudan III are dissolved in the alcohol, and added drop by drop to the melted paraffin with constant stirring. The mixture is now heated until all the alcohol is evaporated. The beeswax is stirred in until melted, heat being used if necessary. Then the resin is added and mixed in thoroughly while the casserole is being heated. The mixture can be poured into molds and cooled.

Do not melt the resin by itself over a hot fire, as high organic acids of a very irritating character are produced which occasion pain to the patient and irritation to the wound. Subsequently the wax cakes should always be remelted in a *double* boiler, for if the boiler containing the wax be placed immediately over the fire, or hot plate, some decomposition of the resin in the mixed formula may take place with all the objectionable results mentioned.

TECHNIQUE OF APPLICATION

After melting the wax preparation in a double boiler it is usually applied in one of three ways:

1. Directly, with a suitable brush;

2. Sprayed on with a spraying device (like an atomizer), the instrument being kept at the proper temperature by an electric coil surrounding the parts containing the wax;

3. Saturating gauze strips, or pieces of sheet cotton, with the melted wax preparation and immediately applying the same to the surfaces to be covered. Sheet cotton, specially prepared for the purpose, has been placed on the market under the name of redintol and is very well adapted for the purpose. After the first layer of wax is applied, by one of the above methods, a piece of gauze or thin layer of cotton is placed over this application, and this is again painted with wax so that the gauze or cotton is firmly embedded in the wax. Some loose cotton is now applied over this and the part bandaged.

When the wounds are very painful or sensitive, and it is not practicable to apply the first layer with a brush, the wax may be applied by one or another of the methods mentioned. Incorporating a layer of gauze or cotton between the two layers of wax enables one to remove the whole dressing in one piece when desired.

When severe burns of recent occurrence are to be dressed, it is well to puncture all blebs and remove all loose dead skin that can be done without giving added suffering, before applying the wax dressing. At the next dressing, it will be found that quite an amount of serum has collected beneath the wax. This should be gently mopped away with cotton sponges together with the removal of all necrotic tissue. Before reapplying the wax it is necessary to dry the surfaces with hot air; otherwise the wax will not stick to the surface. This can be done with an electric hair drier commonly used by hair dressers.

To get the best results burns should be redressed daily. The gentle cleansing of the eroded surfaces, as well as the surrounding skin, of all discharge and necrotic tissue is important. This is probably best accomplished with the cotton sponge saturated with ether, being careful not to rub the granulating surfaces. Here let me say that you should also be careful that no flame be near at hand. An electric hot plate is to be highly recommended for heating the wax.

After the wax is melted in the double boiler, it should be cooled to 120° F. when it may be applied with little discomfort. An ordinary thermometer, placed in the boiler containing the wax, will serve as a guide. After some experience the dresser may not require the use of the thermometer to determine the proper temperature. By applying a film of melted wax on the back of the gloved hand the dresser can obtain a good idea of the temperature from the rapidity with which the wax solidifies and also by the heat tactile sensation of the hand. However, we have yet to see any burns resulting from applying melted wax from the double boiler.

It is certainly wonderful what comfort the properly applied wax dressing affords to patients suffering from painful burns, and it is still more wonderful to note the rapidity with which the healing process proceeds.

Although it requires considerable time to cleanse properly the burned areas preparatory to renewing the dressings, this cannot outweigh the advantages, such as the comfort it affords the patient, the shortening of the period of convalescence, the rapid promotion of epithelialization and the lessened tendency to dense scar formation.

With reference to the paraffin film there may be improvements; at present it is probably the most important addition to surgery in the treatment of burns and granulating surfaces.

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A PRELIMINARY REPORT ON THE SIMULTANEOUS USE OF INDIGOCARMIN AND PHENOLSULPHONEPHTHALEIN TESTS IN SURGICAL DISEASES OF THE KIDNEYS[1]

By ANDERS PETERSON, M.D., Los Angeles, California

IN 1903 Voelker and Joseph brought forth the use of indigocarmin as a test of renal function. They used a 4 per cent solution of indigocarmin, injecting 4 cubic centimeters into the gluteal region. These observers made a careful study of the time of appearance of the dye in the urine, the quality of the color, and the frequency and force of the ejections at the meatus.

Methylene blue, rosanilin, potassium iodid, salicylic acid and phlorizin have been employed to determine the functional capacity of the kidneys, both in various types of nephritis and in surgical diseases of these organs.

Of these substances indigocarmin has been most extensively used, especially in Europe. It has been used to some extent also in America.

Seven years after the original work of Voelker and Joseph, the phenolsulphonephthalein test was brought out by Rowntree and Geraghty. A careful study of this dye was made for a considerable time by these investigators at the Johns Hopkins Hospital and its laboratories.

During the last five years, phenolsulphonephthalein has been used widely both in this country and abroad, the general consensus of opinion being that it is the most serviceable of all functional kidney tests.

Until about one year ago (March, 1915) indigocarmin had been used very little in the clinic of the Los Angeles County Hospital, while the phthalein test had been extensively employed in both the surgical and medical departments.

On May 4, 1915, in the examination of a woman with marked cystitis, it was impossible to see the ureter mouths. Ten cubic centimeters of a 1 per cent solution of indigocarmin was injected into the gluteal region, and catheterization was accomplished after the appearance of the dye.

In collecting the specimen for microscopic examination, a test tube into which a small amount of sodium hydrate solution had been put, was accidentally used, and as the blue-colored urine dropped into the sodium solution, it was noticed that the blue immediately disappeared, and a light yellow resulted. It was the intention to estimate the relative function of the two kidneys by means of the phthalein test, and as it was noticed that the blue disappeared in the presence of the sodium solution, it seemed possible that the phthalein might be estimated in the presence of the indigocarmin. Accordingly, 6 milligrams of phathlein was given intravenously, and two fifteen-minute specimens were collected in the usual manner. Upon diluting with distilled water and adding sodium hydrate solution until the blue disappeared, a solution was obtained very nearly the true bright red of phthalein characteristic in alkaline solution. The quantiative reading was done upon the Hellige colorimeter in the usual way.

Following this accidental occurrence, the following problems presented themselves:

1. Will the color of indigocarmin in all cases be eliminated by sodium hydrate, and a true phthalein color be obtained?

2. Will the same amount of phthalein be excreted by the kidneys in the presence of indigocarmin as when phthalein is used alone?

3. Will the color of indigocarmin interfere with the microscopic examination of the specimen of urine collected during the first part of the examination?

4. Will the growth of bacteria be retarded by the presence of this dye in the specimen?

An effort has been made to establish a suitable dosage for intravenous administration.

The time of appearance of the dye following intravenous administration has been observed.

A curve of excretion of indigocarmin following intravenous injection has been studied in normal persons.

A few essential physical and chemical properties of the dye have been observed and a series of thirty-three patients studied. Twenty-three of the patients presented pathologic conditions of the kidneys and ten, normal kidneys. In the series of pathologic kidneys the earliest time of appearance of the dye was used, that is the time it appeared from the healthy side. The following method was pursued in this series:

1. The cystoscope was introduced and the bladder inspected. The ureters were catheterized, and a sample collected for microscopic examination. A culture was made from each kidney on agar tubes.

2. Four cubic centimeters of indigocarmin solution containing 1 grain of the dye was injected into one of the veins at the bend of the

[1] Presented before the Genito-urinary Section of the State Medical Society and Western Branch of the American Urological Association Fresno, California, April 19, 1916.

TABLE I.

Case	Sex	Condition	Intravenous Indigocarmin 1 Grain	Intravenous Phenolsulphonephthalein 6 mg.	Appearance of Indigocarmin. Minutes	Appearance of Phthalein. Minutes	Amount of Phthalein with Indigocarmin in Half Hour. Per cent	Amount of Phthalein without Indigo in Half Hour. Per cent
1 T. A.	M	T. B. kidney	+	+	12	8	30	30
2 R. L.	F	T. B. kidney	+	+	10	4	37	41
3 H. G.	M	Renal stone	+	+	6	5	50	52
4 F. S.	F	Pyelonephritis	+	+	10	6	16	15
5 D. E. K.		T. B. kidney	+	+	4	4	32	35
6 C. H.	F	Renal stone	+	+	4	4	26	30
7 G. R.	M	Hypernephroma	+	+	3	4	69	65
8 M. A.	M	Tumor of bladder	+	+	4	5	36	35
9 F. T.	M	Pyelitis	+	+	3	5	38	40
10 E. N.	F	Floating kidney	+	+	3	10	51	50
11 J. M.	M	T. B. kidney	+	+	2	2½	35	37
12 G. D.	M	Tumor of kidney	+	+	2	2½	55	40
13 D. B.	F	Pyelitis	+	+	1½	3	56	62
14 F. K.		Pyelitis	+	+	3	3	35	50
15 A. B.	F	Pyelitis	+	+	5	5	46	45
16 T. O. G.		Hypernephroma	+	+	5	5	60	55
17 B. P.	F	T. B. kidney	+	+	2	4	45	45
18 F. W.	M	Pyelitis and enlarged prostate	+	+	7	4½	51	50
19 C. R.	M	T. B. kidney	+	+	6	6	52	55
20 J. D. W.		Renal stone	+	+	4	5	66	65
21 M. S.		Renal stone	+	+	4	6	40	45
22 M. H.		Pyelitis and bladder stone	+	+	4	4	38	40
23 M. M.	F	T. B. kidney	+	+	9	8	46	50

Earliest appearance of indigocarmin in 23 cases..... 1½ minutes
Latest appearance of indigocarmin in 23 cases..... 12 minutes
Average time of appearance..... 5 minutes
Earliest appearance of phenolsulphonephthalein in 23 cases..... 2½ minutes
Latest appearance of phenolsulphonephthalein in 23 cases..... 10 minutes
Average time of appearance..... 5 minutes
1. Average output of phthalein in presence of indigocarmin.....43.93 per cent
2. Average output of phthalein when used alone.....44.87 per cent

elbow. The time of the appearance of the dye at the end of the catheters was noted on each side. A specimen for comparative microscopic study, and a culture for comparison with the ordinary culture were taken.

3. One cubic centimeter of phenolsulphonephthalein was not injected into one of the arm veins and the time of its appearance noted. A half-hour specimen was taken from each side, and the bladder catheterized to measure the leakage.

4. Each specimen was diluted to 250 or 500 or 1000 cubic centimeters with distilled water, and sodium hydrate solution 15 per cent added until all trace of blue disappeared from the solution. The amount of phthalein was estimated in the colorimeter and recorded.

5. The specimens collected from the catheters, both plain and in the presence of indigocarmin, were centrifugalized and examined.

6. After twenty-four to forty-eight hours the two cultures were compared.

7. A few days later the patient was given an intravenous injection of 1 cubic centimeter of phthalein, after the bladder had been emptied by urination or catheterization, and after about 500 cubic centimeters of water had been drunk. At the end of thirty-five minutes the excretion was collected, read in the colorimeter, and

TABLE II.* INDIGOCARMIN INTRAVENOUS 4 CCM.

Case	Sex	Condition	First 15 Minutes. Per cent	Second 15 Minutes. Per cent	Third 15 Minutes Per cent	Fourth 15 Minutes. Per cent	Total 1 Hour. Per cent
1 P. L.	M	Normal	14	4½	3	2½	24
2 L. V.	M	Normal	12	4	4	3	23
3 C. V.	M	Normal	18	3	2	2	25
4 J. W. G.		Normal	15	5	3½	2½	26
5 J. C.	M	Normal	19	6	3	1	29
6 M. S.		Normal	21	2½	2	1	26½
7 J. C.	M	Normal	23	2½	2	1	28½
8 C. S.	M	Normal	18	12	3	1	34
9 W. H.		Normal	17	8	2	1	28
10 H. K.		Normal	15	4	2	1	22

*Average output first fifteen minutes 17.2 per cent.
Average output second and third fifteen minutes 7.7 per cent.
Output for one hour 26.6 per cent.

recorded in a column opposite that estimated on the prior examination.

Upon comparing the two last columns in Table 1 it is seen that the output of phthalein when read in the presence of indigocarmin nearly equals the output when used alone.

The variations lie in the majority of reading within 5 per cent, a fact that can be accounted for as being due to error in the colorimetric estimation.

The average output in twenty-three cases in both instances falls within 1 per cent of each other.

After a comparative examination of the slides and cultures, it was soon definitely found that the presence of indigocarmin did not interfere with such study of the urine. Therefore, this part of the work was not carried out for all of the patients examined being done only when indicated for diagnostic purposes.

In order to administer the phenolsulphonephthalein at a time when the smaller amount of indigocarmin was excreted, an effort was made to determine the period following the intravenous injection of indigocarmin, during which the greater quantity of the dye was excreted, and with this in mind, normal patients were examined in the following manner:

The patient was instructed to empty the bladder and drink a pint of water.

One grain of indigocarmin was given intravenously. Five minutes were allowed for the time of appearance, and collections of the urine made every fifteen minutes for one hour.

A standard solution of indigocarmin was prepared by mixing 4 cubic centimeters of the stock solution or 1 grain with 1000 cubic centimeters of distilled water. This solution was placed into the wedge-shaped cup of the Hellige colorimeter, and the quantity of dye excreted estimated in the same manner as for the phthalein (see Table II). A few patients were observed at the end of the second and third hour. The color became too pale for estimation on the colorimeter at the end of the second hour, and barely a trace could be seen at the end of the third hour.

A study of these cases indicates that only about 25 per cent of the indigocarmin is excreted by the kidneys, and that about 15 per cent is excreted during the first fifteen minutes following its appearance in the urine. During the next half hour about 8 to 10 per cent is excreted by both kidneys, making from 4 to 5 per cent for each side in normal persons.

Transferring these last figures into terms of grains, it will read that only ¼ grain is excreted by way of the kidneys, and this takes place during the first hour.

During the second and third fifteen-minute periods about 1/80 grain is excreted by each kidney in normal persons. It is during this period in order not to prolong the examination that the phthalein can best be collected.

If the collections are made in two fifteen-minute periods, approximately only 1/160 grain should be found in each reading. This amount of indigocarmin requires but a small amount of sodium hydrate solution for its disappearance, only slightly more than that required for the phthalein test alone (about 1 cubic centimeter—15 per cent solution), but enough should be added to destroy any trace of blue.

Should the resulting color not show the characteristic bright red of the phenolsulphonephthalein,

a small amount of the diluted solution should be filtered, as pus, blood, and other débris in the urine may be responsible for the disturbance in the color. If the resulting solution is not the proper texture of color, a filtered specimen should be placed in a small test tube and boiled a few seconds. Boiling in the presence of sodium hydrate will completely oxidize the indigocarmin. The phthalein is not affected by boiling in alkaline solution.

In a given case when there is difficulty in locating the ureter mouths, the following procedure is recommended:

1. Four cubic centimeters of indigocarmin solution is injected into one of the arm veins after the cystoscope has been used for inspection of the bladder. The region of the trigone is kept under observation for the appearance of the blue color. The time of appearance on each side is recorded. The catheters are then passed into the ureters, and specimens collected for microscopic study. Cultures are made if indicated. These procedures will occupy fifteen to twenty minutes.

2. Six milligrams of phenolsulphonephthalein is injected intravenously and the time of appearance on each side recorded. Either a half hour or two fifteen-minute specimens are taken and the bladder emptied to collect any leakage. The quantity of phthalein is estimated as described above.

In the literature perused in this study, there is no complete description of indigocarmin and only a few observations regarding the physical and chemical properties.

Physical and chemical properties. Indigocarmin is the sodium or potassium salt of indigodisulphonic acid ($H_2 C_{16} H_8 N_2 O_2 (SO_3)_2$). It is soluble in water; 0.8 per cent is of a dark blue color. Its reaction to litmus is neutral and can be sterilized by boiling or by steam pressure.

By the addition of sodium hydrate solution, a yellow color results and on the addition of sodium hydrate solution and boiling, a clear solution is obtained.

If sodium hydrate is added to a solution of indigocarmin until all trace of blue disappears, a pale yellow color is the result, while on the addition of acetic acid it again becomes the characteristic blue of indigocarmin. By rendering a solution of indigocarmin distinctly alkaline, and then boiling the solution, a complete oxidation occurs, and the acetic acid does not restore its color.

This behavior of indigocarmin toward sodium hydrate makes it possible to bring out the characteristic red of phthalein by adding sodium hydrate which at the same time changes the indigo into a yellowish tint. By boiling a small sample of the resulting dilution the indigocarmin is completely oxidized, while the phthalein is not affected by boiling in an alkaline solution.

Stability of indigocarmin. In order to determine the stability of indigocarmin, a solution was prepared containing 1 grain to 1000 cubic centimeters of distilled water. Three bottles were filled with this solution:

1. A dark glass bottle.
2. A clear glass bottle containing a small amount of acetic acid.
3. A clear glass bottle.

These bottles were set away on a shelf of an instrument cabinet in the cystoscopic room, and examined after 58 days, in the following manner:

A fresh solution of 1 grain in 1000 cubic centimeters of distilled water was made up, the wedge-shaped cup in the colorimeter filled with this solution, and each sample compared against it.

A similar observation was carried out by adding nitric acid, sulphuric acid and hydrochloric acid to three bottles containing indigocarmin solution, 1 grain to 1000 cubic centimeters, and examined at the end of seventy days.

From these observations it will be seen that indigocarmin is stable in ordinary watery solution and in the presence of acetic acid.

The dye is rapidly oxidized by nitric acid, slightly oxidized by sulphuric acid, and less affected by hydrochloric acid.

By slowly adding sodium hydrate to a solution of indigocarmin, the color first changes to a greenish tinge, and finally to a light yellow. In alkaline urine this variation in color can be observed; i.e., a greenish appearance of the excretion, which can be restored to its characteristic blue color by addition of acetic acid. When resorting to colorimeteric estimation of this dye, a few cubic centimeters of acetic acid should be added to the dilutions to obtain a neutral or acid reaction of the solution.

Indigocarmin is soluble in water in 0.8 per cent. It has been noted that when a stronger suspension of the dye is injected intravenously, transitory symptoms of shock varying from mild manifestations, such as dizziness and pallor, to almost complete collapse will occasionally occur. These manifestations are possibly due to the action of undissolved particles of the dye as momentary thrombi. For this reason the dye should be used intravenously only when in complete solution and carefully sterilized.

A 5 cubic centimeter ampule of the saturated

solution contains approximately three-fourths of a grain of indigocarmin and forms a serviceable and safe method for the test.

CONCLUSIONS

1. When indigocarmin and phenolsulphonephthalein are excreted simultaneously, the addition of sodium hydrate eliminates the color of the indigocarmin and brings out that of the phthalein.
2. Phenolsulphonephthalein is excreted by the kidneys in the same amount whether used alone or simultaneously with indigocarmin.
3. The presence of indigocarmin does not interfere with the microscopic study of the specimen of urine.
4. The growth of bacteria is not retarded by the presence of this dye in the culture.
5. Five cubic centimeters of a saturated solution of indigocarmin forms a suitable and safe dose for intravenous administration.
6. A quantitative colorimetric estimation of indigocarmin can be carried out.

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A RARE DEVELOPMENTAL ANOMALY OF THE RECTUM, WITH A DESCRIPTION OF THE OPERATIVE TECHNIQUE EMPLOYED FOR ITS CORRECTION

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EMBRYOLOGY

THE rectum develops from that portion of the hind gut (Fig. 1, *G*) which grows toward the tail end of the embryo. It is known as the postallantoic gut (Fig. 1., *P. A. G.*). As the embryo grows, the postallantoic gut buds still more backward, and the allantois becomes a ventral diverticulum (*A*. Fig. 2). The communication existing between these two structures is finally obliterated, and the allantois becomes part of the urinary tract. The final steps in the completion of the development of the rectum consist of the meeting of postallantoic gut with the proctodæum (Fig. 3). The latter grows upward from the anal depression in the skin, toward the gut, and pushes the mesoblast aside, until a membrane consisting of epiblastic and mesoblastic epithelium alone, separates the two lumina. This membrane has been termed by Minot (1) the "anal plate." (Fig. 3 *A. P.*). In the human embryo, this plate becomes perforated, according to Ball (2), at the end of the fifth week, and the vestigial remnants are represented in the adult as the anal valves. In the lower animals, Minot (1) has observed, that the anal plate does not become perforated at once, but that it is first converted into a "cord of cells," and as the tail curves more anteriorly, this "cord" shortens, and a membrane composed of two layers of epithelium again appears. Then

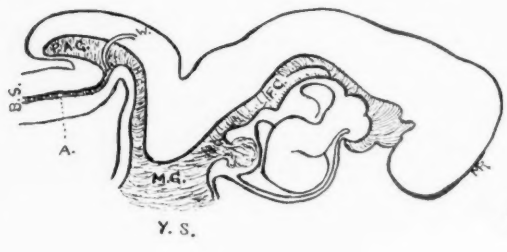

Fig. 1.

Fig. 2.

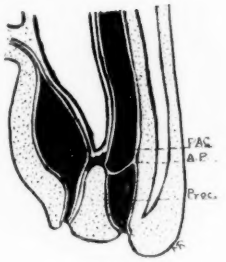

Fig. 3.

Fig. 1. Diagram of the intestinal canal of a very young human embryo (from Ball). *F. G.*, foregut; *H. G.*, hind gut; *P. A. G.*, postallantoic gut; *M. G.*, midgut; *B. S.*, body stalk; *A*, allantois; *Y. S.*, yolk sac; *W.*, wolffian duct.

Fig. 2. Vertical section of an embryo (Wood Jones). The postallantoic gut (*P. A. G.*) is budding backward in the growing hind end, and the allantois (*A*) has become a ventral diverticulum.

Fig. 3. Vertical section of a still older embryo (Wood Jones). The postallantoic gut (*P. A. G.*) has met the proctdaeum and has lost its connection with the allantois. *A. P.*, anal plate.

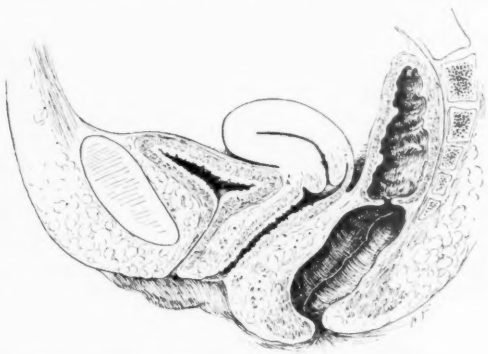

Fig. 4. Drawing showing fibrous band dividing the dilated rectal pouch into two irregular chambers. Author's case.

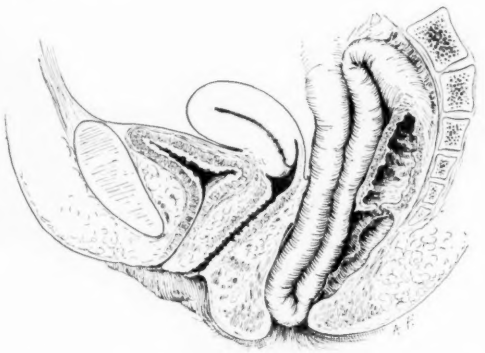

Fig. 5. Drawing showing the detached portions of the sigmoid and upper rectum which has been brought down to the anal margin. Author's case.

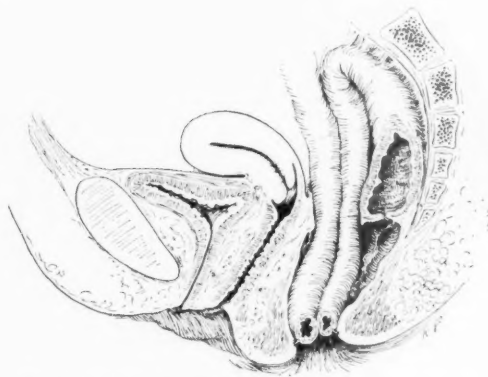

Fig. 6. Double barreled lumen produced in author's case.

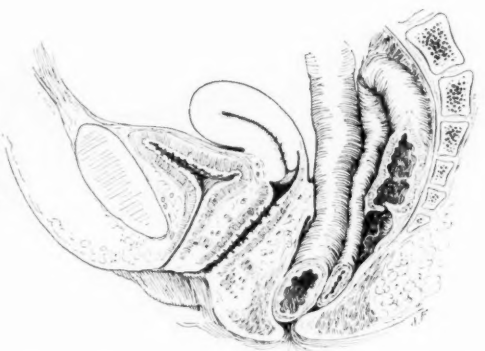

Fig. 7. Morphological condition of the rectum in author's case.

only does it perforate, and a permanent opening is established. With the aid of this brief embryological review, the anomaly in the case which is herewith reported will probably be better understood:

Della K., age fourteen, began to menstruate at 12 years and 6 months, every five to six weeks, profuse in amount, lasting from six to seven days. Occasionally she suffers from dysmenorrhœa, after the onset of the flow. Her last period occurred four weeks ago.

Previous diseases: with the exception of chorea, three years ago, has never been ill.

Present illness: For the past five years, she has been suffering from obstipation, which is gradually growing worse. At present her bowels move once in four or five days, and that by means of an enema only. In addition to the marked constipation, she is also troubled with backache, lassitude, and irritability. One month ago she was suddenly taken ill with an attack of abdominal cramps localized to the left lower quadrant, followed by rectal hæmorrhages which lasted for two weeks.

Physical examination. Her height and weight are slightly above normal, heart, lungs, abdomen, and external genitalia normal. At a point, about three and a half inches from the anus, corresponding in location, to the lowest of Houston's valves, a constriction is encountered, with a lumen not larger than the diameter of the little finger, surrounded by a distinct tough membranous rim. From this area downward to the internal sphincter ani, the rectal ampula consists of an extremely dilated pouch, with thin walls, devoid of the usual corrugations in the mucosa, which form the columns and the sinuses of Morgagni. Traversing this pouch in a longitudinal direction, and in a zigzag fashion is a fibrous band, which divides it into two irregular chambers (Fig. 4).

Operation. On March 9, 1915, I performed the following operation. With the patient in the Trendelenburg position, the peritoneal cavity was entered through a left rectus incision. On palpating the rectum, the constriction which was felt from within, could now also be perceived by the examining fingers. About five inches of the sigmoid, and the rectum up to its peritoneal reflection were freed from their mesenteric attachments. A pedicle clamp was introduced into the rectum, making it impinge against the anterior wall, at a point a little below the site of the constriction. An incision through the posterior cul-de-sac, over the point of the clamp was made, and a communication established with the lower portion of the rectum. The clamp was now pushed into the peritoneal cavity, the piece of tape which was previously fastened to the freed loop of intestine, was grasped and pulled down, bringing with it, the detached portions of the sigmoid and upper rectum, to the anal margin (Fig. 5). The peritoneal edges of Douglas' cul-de-sac were now sewed to the edges of this loop, thus rendering it extraperitoneal. The abdominal cavity was closed in the usual manner, and the patient placed in the lithotomy position. The sphincter ani was dilated, and the intestinal loop fastened with a few interrupted sutures to the anal mucosa. The anterior or lower wall of the loop was incised, thus producing a double barreled lumen (Fig. 6). Rubber tubing was introduced into the proximal and the distal ends, secured temporarily in place, dressings applied, and the patient returned to bed.

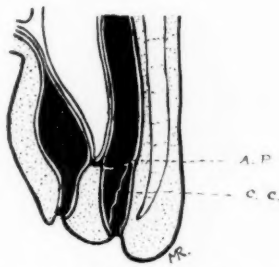

Fig. 8. A diagramatic representation of the most probable embryological defects that have caused the anomalies in the case reported. *A. P.*, anal plate but partly absorbed; *C. C.*, cord of cells which correspond to the hand in the rectum.

The postoperative course was most satisfactory. On the seventh day the patient was again placed in the lithotomy position, under gas oxygen anæsthesia, with the idea in mind, to crush the existing spur, and make the aboral end of the newly constructed rectum much wider. However, an examination disclosed that the intestinal partition had retracted of its own accord, making the contemplated operation unnecessary. The morphological condition of the rectum at present is well illustrated in Figure 7. The distal portion of the loop, is represented by a narrowed diverticulum, the proximal portion is wide, and forms the terminal segment of the rectum continuous above with the sigmoid. The finger or proctoscope enters without encountering any obstructions, the spur can still be felt high up and to one side. Since her complete recovery from the operation, the patient has been free from constipation, requiring no laxatives, cathartics, or enemata. She is pursuing her studies with diligence, and is enjoying good health.

EPICRISIS

The constriction in the rectum corresponds to the site of the "anal plate," which has not become completely absorbed (Fig. 8). The fibrous band that was present in the rectal pouch, below the point of constriction, is probably the "cord of cells" (Fig. 8, *c. c.*) described by Minot as occurring in the lower animals, and it may therefore be considered as a reversion to a remote ancestral embryology.

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TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD JANUARY 5, 1917, WITH THE PRESIDENT, DR. WILLIAM M. HARSHA, IN THE CHAIR

COMPLETE COLECTOMY FOR VOLVULUS OR THROMBOSIS

DR. NORMAN KERR: Many surprises have been met with by almost all surgeons and the writer believes he has encountered the most startling in the literature, as the following history will probably prove.

The patient, a woman, age 47, weight 112 pounds, has had two children, now 19 and 23 years old, was operated upon for uterine fibroid two years ago, by Dr. H. O. Shafer, at which time he also removed the appendix. Nothing abnormal was noted about the colon. She made the usual uninterrupted recovery and suffered no inconvenience except from constipation, which seemed to increase after this operation, and she had two or three attacks of colic from which she recovered, with the use of enemas.

On August 24, 1916, she was seized with severe pain in the left lower quadrant of abdomen and her attending physician, W. J. Schaefer, succeeded by various enemeta, in bringing away a fæcal mass, six inches long by nearly two in diameter. The bowels were obstinately constipated the next day and on the second day, August 26, she was again seized with pain in the left lower quadrant of abdomen about 11 a.m. and Dr. Schaefer saw her about 1 p.m. at which time he detected a mass in the region of the sigmoid and advised immediate operation. During all this time, the patient's abdomen remained flat and the pain was becoming continuous. She was admitted to the Henrotin Memorial Hospital where she was examined at 6:30 p.m. by Dr. Schaefer, just before the operation, when her abdomen was distended to the size of a full-term pregnancy and the patient still complained of severe pain. A median incision of eight or ten inches revealed a dark cyst-like mass which extended up on both sides of the abdomen and crossed it above the line of the upper end of the incision. This was removed from within the abdomen and found to be the whole of the colon and sigmoid flexure with a twist in the pedicle (if I may so term it) just above the sacrum.

The position of the cæcum was to the right side; the whole of the mesocolon, ascending, transverse, and descending, was separated from the colon so that when the pedicle was untwisted, it required one complete turn from left to right.

A clamp was applied to the ileum pedicle and colon, the gangrenous colon cut away and a lateral anastomosis performed between the ileum and colon, just above the sacrum. The open end of the colon, three or four inches above the sacrum, was slightly discolored and it was thought advisable to invaginate about an inch before applying the circular sutures. The end of the ileum was invaginated in the usual way, several large cigarette drains were placed along the line of the attachment of the ascending and descending mesocolon to the posterior abdominal wall, the incision sutured, and the patient was returned to bed in good condition.

For several days, a large amount of serum drained away; otherwise nothing untoward occurred until she became troubled with diarrhœa, because she had no colon to absorb the liquid portion of the contents of the small bowel. This gradually improved with regulation of the diet, until she would go twenty-four hours without a bowel movement.

Dr. Aloys Heinen made an examination of her stool on October 16, 1916, and reported as follows: Gross appearance — well formed, of a dark brown color, slightly sticky, a fairly good odor. Macroscopically on maceration very little connective tissue, some fat. Microscopically, some well digested muscle fibers, a very few undigested single muscle fibers, two parts containing 10 or 15 muscle fibers enveloped in connective tissue. Starch, non-undigested starch granules. Fat, some neutral fat globules undigested. Some detritus cellulose plant cells or fibers. Nothing pathological otherwise except above mentioned undigested muscle fibers and fat.

In a personal conversation with Dr. Heinen, he

informed me that some German investigator showed that the colon played an important part in digestion: for instance, the discharge of a fistula from the cæcum would show many undigested muscle fibers whereas that from the descending colon or sigmoid would show very few if any — an important point for consideration, it would seem to any one contemplating the operation of short circuiting or complete colectomy.

The history would seem to show that the volvulus commenced in the sigmoid portion of the colon, traveled upward to the splenic flexure, across to the hepatic, then down to the cæcum, separating in its course the mesocolon from the different parts of the colon in its progress upwards, because the primary symptoms were referred to the sigmoid and the separation must have taken place from below upward and one complete revolution from left to right was the only possible way in which such a twist in the attachments of the mesentery of the ileum and mesosigmoid could have occurred. It was noted that there were four bleeding points when the clamp was loosened; one near the ileum, presumably the terminal loop of the mesenteric artery, two larger ones near the middle of the pedicle, and the fourth near the pelvic colon. There was no venous oozing to control and as haste was considered important, the writer did not attempt to investigate the neighborhood of the transverse mesocolon although it was noted the distended colon showed areas of denudation of the peritoneum in its whole length.

A new problem in etiology was presented by this case which the writer tried to have cleared up by his surgeon friends in Chicago, but to no avail.

I confess I cannot explain why this remarkable condition should occur, viz., such an extreme distention of the colon as to cause tearing of the mesocolon, which seems hardly possible, as the cæcum, the most distended part, was not more than six inches in diameter, or again, who has ever heard of a volvulus causing such tearing of peritoneal supports in any part of the abdomen.

One point in the history may help to clear up this question; viz., she had had two or three attacks in which bleeding from the lower bowel, took place within the last year. The specimen has not as yet been examined for any growth from the mucosa.

Dr. Adolph Hartung very kindly took some roentgenograms of the rectum and abdomen which are remarkable in that they show a fairly good imitation of a transverse and descending colon, also a fair imitation of a cæcum and after he was told what the operation was, he could not explain the shadows as shown. The patient afterward came to his office, was given a bismuth meal and rayed, at three different periods and the roentgenograms show that the small intestine must have adhered to the denuded surface of the mesocolon and given the above-mentioned startling imitation.

DR. ALOYS HEINEN: On examining the stool of Dr. Kerr's patient I found connective tissue, which proves that the stomach function was below normal. This was verified later by making an analysis of the stomach contents, in which I found achylia gastrica, also some undigested muscle-fibers, and a few undigested starch granules. Some fat globules were also found in the stool.

As such operations are performed to cure colonic statis, we should not lose sight of the physiologic function of the colon and the enormous amount of absorption which takes place in that organ. If we consider the amount of fluid in the contents of the bowel as it passes from the ileum into the colon, and, after passing through the colon, the solid state when finally expelled, we will realize the amount of absorption that takes place in the colon.

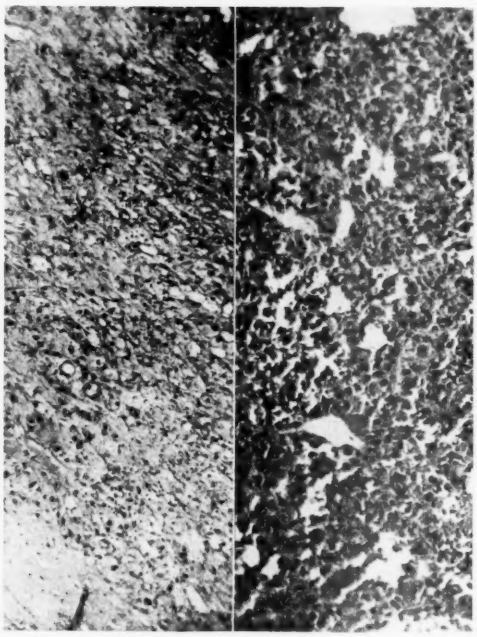
As to the muscle-fibers, it has been proved by forming a cæcal fistula that digestion takes place in the colon, for examination of the discharge from the fistula reveals undigested muscle-fiber while that of the stool later shows digested fiber, which can be understood when we know that the stool contains trypsin.

Before resorting to such severe operations for constipation, we should ascertain whether the constipation is due to any organic disturbance, such as obstruction, adhesion, etc. This can be determined by examination with the rectosigmoidoscope, roentgen-ray, etc. My experience in these cases has been that constipation is due in most cases to a functional disorder, although there are always some organic changes caused by improper living; for example, improperly cooked food or improper eating hours, etc.

We ought to begin with the stomach examination in making our diagnosis, as many of the cases are of a gastrogenic origin, and, I am sure, we can cure nearly all of the cases by bringing the patient back into a proper mode of living.

DISCUSSION

DR. DANIEL N. EISENDRATH: It does not seem to me as though Dr. Kerr's case is so rare. I have had two cases, duplicates of these. Both of them proved to be volvulus of a megacolon



Hepatic hypernephroma. Dr. Carl G. Swenson's case. Slide on right magnified 500 times.

or Hirschsprung's disease. His specimen is quite typical of that condition. The immense size of the gut, the enormous thickening of the walls show that this is not a condition which has existed for a few months but is a congenital condition.

HYPERNEPHROMA OF THE LIVER

DR. CARL G. SWENSON: My object in presenting this specimen is to obtain the opinion of the fellows of the Chicago Surgical Society as to the diagnosis. The patient's weight eighteen days after the operation was 120 pounds but it has now increased to 155 pounds. She is at present in perfect health.

The patient, a woman of 58, was admitted to the Passavant Hospital, April 4, 1916.

Previous history. The patient has always enjoyed good health. She was married at nineteen and has given birth to eleven children.

History of the disease. The patient has been ill for one year. The first symptoms noticed were constipation and abdominal enlargement in the epigastric and umbilical regions. In September, 1915, the patient discovered by manipulation, a lump in the epigastric region. For two months, February and March, 1916, the patient was unable to lie down in bed, but was obliged to sit continually in a chair.

Examination. By palpation, a large oval-shaped, smooth, hard, and movable tumor was found in the epigastric and umbilical regions. It measured in its three diameters 25x25x20 cm.

Diagnosis. Probably a malignant growth. It was difficult to determine the origin of the tumor. It might have arisen from the mesentery, omentum, transverse colon or liver, or it might possibly have been a fæcal mass.

Blood examination. Erythrocytes 5,500,000, leukocytes 9,600, and hæmoglobin 75 per cent. Urine normal.

Preparatory treatment. (After the patient's entrance into the Passavant Hospital.) On alternate days during three weeks she was given two to three ounces of castor oil and one ounce magnesium sulphate and in addition daily enemata and colonic flushings. From this eliminating treatment the tumor was reduced to its real size, 12x12x8 cm.

Operation April 25, 1916. Anæsthetic. Ether five ounces. Morph. sulph. gr. ¼ hypod. The anæsthesia began at 9:30 a.m. and discontinued at 10:00 a.m. An incision 12 cm. in length was made through the right rectus muscle. On opening the abdominal cavity a very vascular, smooth, and dense tumor was found adherent to the inferior surface of the liver. The gall-bladder was free and normal. To the left costal arch, the tumor was attached with an omental band.

By blunt enucleation, the tumor was separated from the liver to two cm. within its lower edge, where further enucleation became impossible. Therefore, in order to liberate the tumor, the edge of the right hepatic lobe was excised two by ten cm. and the tumor removed. There was no excessive bleeding after excision of the liver edge. The diameter of the tumor measured 12.5 cm. and it weighed two kilograms. A large plain gauze drainage pad was placed under the liver and the wound sutured.

Postoperative report. April 26, temperature 97°F. to 98°F. Pulse 116 to 104. April 27, temperature 100°F. to 103°F. and 105°F. Pulse 124 to 145 and intermittent. The removal of drainage gauze caused the rising temperature and intermittent frequent pulse.

April 28, temperature 98.6° F. to 100.8°F. Pulse 106 to 112. On the tenth day after operation the temperature became normal and on the sixteenth day the patient sat up on a chair. On the eighteenth day she weighed 120 pounds. Five weeks later her weight had increased to

134 pounds, a gain of fourteen pounds. Her weight on entering the hospital was 140 pounds and previous to her sickness, her average weight was 180 pounds. On September 26, the patient weighed 144 pounds, an increase of ten pounds since June.

The patient left the hospital June 20, eight weeks after operation, with an abdominal fistula. This fistula closed September 18, twenty-one weeks after the operation.

Ever since the patient returned home from the hospital she has done her usual daily housework and continues to enjoy good health. January 1, 1917, the patient weighted 155 pounds, an increase of 35 pounds.

Pathological report. Numerous sections were taken from the tumor and mounted on slides for microscopical examinations. The slides have been examined by four eminent pathologists of highest authority. The conclusive diagnosis reached by them differs. Positive diagnosis by Professor Ludwig Hektoen and E. R. Le Count, states the tumor to be a hepatic hypernephroma; by Professor Maximilian Herzog, an endothelioma; by Dr. William C. McCarty, Rochester, Minnesota, primary carcinoma of liver. For various reasons drawn from the clinical result the indications strongly favor the diagnosis, hepatic hypernephroma, given by Professor Hektoen and Le Count, as the most correct one.

Present condition, August 13, 1917. Weight 131 pounds. By manual examination the recurrence of the tumor was found in March, 1917. Present size of tumor, located in right hypochondriac region, is about 15x10 cm. Patient eats and sleeps good and she feels well and comfortable.

DISCUSSION

DR. LECOUNT: I wish to mention the following characteristics of hypernephroma:

1. The great disposition of these tumors to invade the renal vein and also to be carried by lymph-channels producing secondary growths in the lymph-glands, not only in the abdomen, but in the thorax as well.

2. As to the controversy that has been had over the origin from renal tissues, the present evidence seems inadequate. Hypernephromata occur as primary tumors of the liver and of the adrenals as well. The tumors generally grow in structures developed from the wolffian body.

3. The characteristics of the histological structures: the occurrence of huge cells full of holes in the usual preparations, and of fat molecules in preparations, stained to demonstrate it; the arrangement of these cells in rows; the lack of stroma; and the frequency of necrosis.

4. The orange yellow color of the surfaces made by sectioning the fresh tumor growth.

5. The frequent occurrence of metastases in bone.

DR. A. J. OCHSNER: It is perfectly clear from these pictures that Dr. Swenson's case is a hypernephroma and nothing else, but the diagnosis can be confirmed later on by the autopsy. Every one who has seen many hypernephromata knows that very commonly a tumor is found elsewhere first, and later on a tumor is found in the suprarenal gland, which may be very small, and that the metastatic tumor is simply a portion which has accidentally been separated and has become lodged somewhere else and started the tumor which one mistakes at first for a primary growth. The whole structure is so typical that it cannot be anything else.

OPEN SURGICAL TREATMENT OF BONE AND JOINT LESIONS

DR. CARL BECK read a paper entitled "Open Surgical Treatment of Bone and Joint Lesions."

CYSTICODUODENAL AND CYSTICOCOLIC LIGAMENT

DR. WELLER VAN HOOK read a paper entitled "The Surgical Significance of the Cysticoduodenal to the Cysticocolic Ligament." (See p. 551).

DISCUSSION

DR. M. L. HARRIS: It will be remembered that two years ago I presented before this society a paper on the structures which the doctor has spoken of tonight. At that time I endeavored to show that these structures are due to the persistence of the caudal edge of the anterior mesogastrium. The anterior mesogastrium during embryologic life extends from the abdominal wall in front back to the gastro-intestinal tract and later its remains occupies a position to the right of the duodenum by reason of the turning of the duodenum to the right. When this caudal edge persists, it may persist as a distinct fold extending from the anterior abdominal wall to the intestines, or it may persist simply as a fold or band from the liver to the intestine, or from the gall-bladder to the intestine, and the hepatoduodenal ligament is but a remnant of the caudal edge of this anterior mesogastrium. The reason this fold occasionally extends from the gall-bladder to the colon as the so-called cysticocolic liga-

ment is due to the fact that when the colon turns over from the left to the right, it comes in contact with the caudal edge and takes attachment to it and carries this fold along with it.

Since I called attention to the persistence of this anterior mesogastrium, it has been confirmed by others, and shortly after I presented that paper an interne brought me a beautiful specimen which he had just found at the Cook County Hospital while making an autopsy on a stillborn child. Having read my paper he recognized this anterior mesogastrium and brought the specimen to me. It was a beautiful specimen of the persistence of the anterior mesogastrium from the duodenum along the surface of the liver to the anterior abdominal wall, showing that in this stillborn child the anterior mesogastrium had not disappeared, and probably would have persisted into adult life as a distinct fold had the child lived. In my paper I called attention to the persistence of the anterior mesogastrium in various degrees, its effect on the duodenum, and its effect upon the gall-bladder.

Dr. David C. Straus: I wish to speak of a case of similar nature that I saw about three weeks ago. The case was brought to me with the diagnosis of acute appendicitis. Before I examined the patient, I obtained an appendix history and a gall-bladder history that was just as definite. On examination, the appendix was palpable and very tender, but, in addition, the patient was very tender under the right costal arch, and gave a history of having more or less constant pain in this region, and, in addition, typical gall-bladder colics which came on with pain in the gall-bladder area, radiating anteriorly toward the median line and then deeply upward into the chest, and pain radiating to the right shoulder. From her story it was clear that most of her trouble was from her gall-bladder. To be absolutely certain that there was no duodenal or gastric ulcer, in addition to the usual test meals, I made a thorough roentgenological examination of her gastro-intestinal tract, and was surprised to find she had marked gastroptosis. While I was examining her before the fluoroscope, without asking her anything about her pain, I made firm pressure against her hypogastrium, pressing with both of my hands, thus supporting her stomach so that the greater and lesser curvatures were held up in a normal position. She at once volunteered that she felt much better. When I released the pressure, her pain returned again.

At operation I made a regular gall-bladder incision through the right rectus muscle, and on examining the gall-bladder, found that it was quite large, thin-walled, and that there were two broad bands, which I believed were adhesions, uniting the gall-bladder to the duodenum and to the transverse colon. These were on the free surface of the gall-bladder and extended from the cystic duct almost to the fundus. They were similar in distribution to those which Dr. Van Hook has described and illustrated, and they were as definite and as extensive as those he showed in his last lantern-slide, which were marked. In my case, however, they were heavier than in any of the pictures shown tonight. Because of the enlargement of the gall-bladder and the history, I believed these bands were adhesions, and I felt convinced that the more or less constant pain in the gall-bladder region which she had had for 5 years, had been due to the fact that the ptosed stomach dragged the colon downward, and this in turn, through the band uniting the colon with the gall-bladder, made traction on the gall-bladder and this caused the pain of which the patient complained, particularly when she was up and about.

I did a cholecystectomy, and then, after I had finished the operation, I reached down from the gall-bladder incision to feel the appendix. I could distinctly feel that the appendix was enlarged, contained two enteroliths, and that its walls were greatly thickened. There were no adhesions about the appendix, but it was kinked on itself. It was indicated to remove the appendix, inasmuch as the history and clinical findings pointed to a diseased appendix. I made a small muscle-splitting incision and took out the appendix from below.

The gall-bladder, after removal, was opened and showed the typical picture of a "strawberry gall-bladder." The histological examination, made by Dr. Schultz, showed lymphocytic infiltration of the gall-bladder wall, and, in addition, showed that the mucosa was denuded in areas. The appendix showed chronic hyperplastic appendicitis, and subacute catarrhal appendicitis. The patient made an uneventful recovery, and left the hospital 2 weeks after the operation. There has been no more pain in the gall-bladder region. I had a gastroptosis belt made for her before she left the hospital.

This particular patient's history dated back to a confinement 5 years ago, and I thought the inflammatory condition probably developed during the pregnancy. It may well be, however, that that pregnancy was the cause of her gastroptosis, and that the more or less constant pain in the gall-bladder region since that time, was due to a dragging on the ligamentum hepato-

colicum, at times kinking the gall-bladder and causing obstruction, and secondarily, cholecystitis. In substantiation of this is the fact that when she lay in bed, at night, she felt much better. The reason the ligament was so thick in this case was probably due to sclerosis caused by the constant pulling and dragging it sustained, caused by the gastroptosis.

In closing, I wish to state that it seems probable to me, that if a patient with a well marked ligamentum hepatocolicum, develops gastroptosis of high grade, the traction of the stomach, dragging down the colon, and this in turn pulling on the gall-bladder, may give rise to typical symptoms of chronic cholecystitis, and, in case of kinking at the neck of the gall-bladder, or cystic duct, so that the gall-bladder cannot empty itself, may give rise to typical attacks of gall-bladder colic.

THE SILENT COMMON DUCT STONE

DR. DANIEL N. EISENDRATH read a paper on "The Silent Common Duct Stone."

CHICAGO GYNECOLOGICAL SOCIETY

CLINICAL MEETING AT THE COOK COUNTY HOSPITAL, FEBRUARY 16, 1917

THE REGULAR MONTHLY MEETING OF THE CHICAGO GYNECOLOGICAL SOCIETY WAS HELD IN THE SURGICAL AMPHITHEATRE OF THE COOK COUNTY HOSPITAL ON FEBRUARY 16, 1917, WITH PRESIDENT, DR. CHANNING W. BARRETT, IN THE CHAIR

GENERAL PELVIC PERITONITIS

DR. CAREY CULBERTSON showed four cases of general pelvic peritonitis and stated: I prefer the diagnosis of general pelvic peritonitis rather than that of "pus tubes." These cases were all advanced, in which the tubes, ovaries, and pelvic peritoneum, with more or less of the cellular tissue, were involved. They are shown in order to demonstrate the method of treatment employed in acute and subacute stages, in preparing them for the radical operation if they came to that later.

At the County Hospital the greater proportion of cases of pelvic peritonitis occurs in women between the ages of fifteen and twenty-five; a few of them only being older. As a result of their youth the tendency has been toward conservative treatment in order to preserve menstruation later if the patients come to operation.

CASE 1 demonstrates this condition very well. She is a girl twenty years of age, a domestic, who came into the hospital on February 3 complaining of pain in the hypogastrium and leucorrhœa. The onset had been two weeks previously. About the middle of January there was a sudden onset with acute, sharp pain in the hypogastrium which confined her to bed. She had fever at that time and a slight chilly feeling but no nausea. She had had leucorrhœa for some time, did not know how long. One year ago she had an induced miscarriage, following which she had pain in the hypogastrium and was confined to bed for about a week. She came into puberty at 14; menstruation had been regular every 4 weeks lasting for 3 or 4 days. She had had only the one pregnancy.

When she came into the hospital she had a temperature of 101.2° F., 101.4° F., 101.6° F., 101.8° F., varying from 98.8° F., to 101° F., for several days. I saw her first on Tuesday and at that time the temperature was 101.2° F., she had been in bed for several days. There were 14,000 leucocytes.

Examination. The abdomen was distended and tense, with tenderness and rigidity just inside of the right anterior superior spine. The uterus was large, retroverted, soft, tender and fixed. The right side of the pelvis was occupied by a large mass which bulged down into the vaginal fornix posteriorly. The cervix was pushed forward behind the symphysis. The mass gave a semi-fluctuant sensation on palpation, not as clearly fluctuant as the retroperitoneal abscess in postpartum sepsis.

Considering that she had this mass I requested Dr. Barrett to drain her pelvis the next morning, which was done, thus evacuating a large amount of pus on the 14th. On the 15th, the temperature was 101.6° F., and since then it has not been above 99.4° F. This patient will be allowed to drain for sometime; if the fever stays down it is an indication that the pus is draining out. After the patient has been afebrile for some time she will be kept in bed absolutely quiet until the draining ceases and by that time we can decide whether any other operative procedure is necessary.

CASE 2 is that of a colored girl, nineteen years of age, who came into the hospital on February 12, complaining of pain in the hypogastrium, leucorrhœa, dysmenorrhœa, and constipation. One year ago she had a little leucorrhœal discharge which persisted until the present time but never necessitat-

ed wearing a napkin. The patient now menstruates five days instead of three as she did prior to this onset. Four days ago she had pain in the hypochondrium, colicky in nature, becoming more severe until she entered the hospital. Dysuria began about this time, associated with pain. Constipation has been present for a long time, the patient using cathartics constantly. She has had the diseases of childhood only and three-day periods regularly every month. She has missed no periods. Blood examination shows 15,000 leucocytes.

Examination on Monday showed a rather tense abdomen on palpation, no localized pain. The vagina was negative; the cervix was forward and up, slightly œdematous and free. The uterus was retroverted, a tender mass on either side filling the pelvis but not bulging down as in the case before and not giving evidence of fluctuation.

The temperature has not been very high. This represents an acute exacerbation of an old chronic process. The temperature has run along 99° F., 99.2° F., 99.4° F., practically afebrile, but owing to the tenderness and slight rigidity of the abdomen and the pain, I consider this a subacute process and not to be invaded abdominally at the present time. The patient will be kept in bed until the temperature entirely subsides and then decision will be made as to further treatment.

This case does not require drainage in its present state. When these cases clear up and become afebrile and the abdomen becomes soft, we do not find drainage of the pelvis necessary. Where patients have been in bed and the temperature continues, especially if accompanied by chills, we are practically certain that the patient is developing an abscess and examination will then reveal a soft mass which upon incision turns out pus. This case is not going through that process. The difficulty in many of these cases is to keep them in the hospital. As soon as they become afebrile they wish to go home and often are permitted to, but they only have another exacerbation and soon return.

Case 3 demonstrates what has just been said. This girl is twenty-one. She came in on January 24, giving the history of pain in the right side at McBurney's point and leucorrhœa which began about two months ago, rather severe and causing her to double up. At that time she was unable to lie quietly because of the pain. There was no temperature or vomiting. Four weeks later she had a similar attack but not so severe. One week ago she had her third attack. Leucorrhœa had persisted for three or four weeks before she came in, but not so profuse as at first. She has been married five months, has been sick for three months. She began to menstruate at seventeen, every thirty days, two days at a time with some pain, but not very much. There is no history of infection. There is a leucocytosis of 15,000. When she came into the hospital, examination showed that there were no tender points or masses in the abdomen. The abdominal wall was thin, firm and soft. The vagina was narrow, deep, and distensible. The whole uterus was antiposed and densely fixed. The pelvis was occupied on both sides and posteriorly by dense hard masses which were tender. She had a little fever when she came in; it was evidently a relatively recent infection. The temperature varied from 99.6° F., to 101° F., on January 25. She was put to bed and kept quiet on a light diet with free elimination with the idea that this would clear up without operative interference but it did not do so. On the 28th the temperature was 101.2° F. This persisted every day, not going below 99° F. at any time. Instead of becoming afebrile she continued to have hyperpyrexia until as recently as February 7. On the 10th of February it was 101.2° F. This is the type of case referred to when it was stated that if they continue running a temperature pus nearly always develops. Examination on the 15th showed this to be the case in this instance. The left side had cleared up fairly well; there was no hard mass; on the right side there was a big semi-fluctuant mass which bulged well down posteriorly to the cervix. This morning the posterior vaginal vault was opened and pus evacuated — 10 or 12 ounces.

Case 4 is a patient who entered the hospital on February 3. She is one of the few cases of this type over twenty-five, being thirty-two years of age. She came in complaining of dysuria, painful menstruation and constipation. One week ago she began to have pain on urination, an acute pain which appeared just before the flow started. Pain on defæcation appeared just before the bowels were evacuated. Constipation had been present for six years, leucorrhœa for two years. One week ago the patient menstruated for ten days with the passage of clots. Four days ago there was more bleeding and clots. She has missed no menstrual periods, and has been married four years. She began to menstruate at 21 and since then has menstruated every month for ten days at a time. There is no history of any previous acute onset. There was a leukocytosis of 12,500 when she entered the hospital, hæmoglobin 85 per cent.

Examination of the abdomen showed that it was soft but there was a moderate voluntary rigidity below the umbilicus. The vagina was negative; the pelvis was occupied by a soft mass extending downward. Fluctuation was not discernible. It was a question whether she had any amount of pus in her pelvis or not. We thought she had a general pelvic peritonitis but the condition did not give us the idea of any considerable amount of pus in the pelvis. However, she had a little temperature, 99.4° F., 99.8° F., 100° F., and that was as high as it went. We cannot always be certain whether we have any considerable amount of pus in these cases, an amount that will justify drainage through the vagina or through the abdomen; but even with that slight degree of fever I did not like to go into this case through the abdomen. These cases do not

get well properly after being operated upon in that way and peritonization at the time of operation is well nigh impossible. In this case I was not any too certain in regard to her history; we must use our own judgment in estimating the value of these histories. Not being certain as to whether there was pus or not I might have left the patient in bed for a few days to see whether the condition would clear up, but I also rather favor colpotomy for diagnostic purposes. I do very few exploratory laparotomies, but exploratory colpotomy or colpocœliotomy I do oftener. I do not like to open the abdomen because I dislike to drain abdominally, so in these cases I do a posterior colpocœliotomy and in this one I got a relatively inconsiderable amount of pus, only a few ounces in the right tube and none from the left. Since then the leucocytes have gone down to 9,000, the temperature has not gone down entirely. She still runs about the same temperature she had before opening up the pelvis. It ran 99.6° F., 99.2° F., 100° F., on the 12th and on the 14th.

This brings up one point in the question of colpocœliotomy in these cases and that is whether in a case in which little or no pus had developed you might not open up the pelvis to infection. I occasionally see a case like this in which, the vaginal vault having been opened, I fear that perhaps secondary infection has been introduced through the vagina. That may be the circumstance here, but the patient is feeling considerably better and having less pain and aside from the fact that the temperature is not entirely cleared up she is better. As far as the leucocyte count goes, it is of little surgical significance in the absence of fever. Many of these old chronic cases which have pus and a leucocytosis of 12,000 or 15,000 are afebrile for months and are perfectly safe operative cases.

These cases emphasize the value of draining any considerable amount of pus that may be in the pelvis before undertaking operation through the abdomen. Such preliminary treatment certainly makes possible a more conservative operation, always desirable in these young women. But its chief value lies in the fact that extensive peritonization is made possible and hence abdominal drainage becomes unnecessary. I very seldom drain a "pus tube" case abdominally. Besides all this, occasionally one of these cases will clear up after colpocœliotomy as nearly as we can tell by digital examination. This patient to all gross appearances is well and these cases we let go without any further operation.

MISCELLANEOUS CASES

DR. CHANNING W. BARRETT: This young woman presents an interesting condition. She came to the hospital in June, 1916, for acute appendicitis. She is twenty years of age, not married, and we found on taking the history that she had had twelve previous operations in the region of the rectum; one upon the nose and one on the throat, which with the operation for appendicitis made in all fifteen operations previous to our seeing her. The first operation on the rectum was performed when she was four days old as she had no normal anal orifice. It is not known whether the rectum opened into the vagina at that time or not but perhaps as she was operated on so early there was none. She had had eleven subsequent operations in an effort to establish an anal opening and close up a rectovaginal fistula. She had no control of the fæces except when very solid. She had about given up hope but was urged by the interne after her operation for appendicitis to have an effort made to establish an anal opening. It was perfectly plain on examining her that an effort to close the rectovaginal opening with the perineal tissues existing as they did would be a failure. We had to use some other method than merely trying to close the fistula. The fact that in many perineorrhaphies in which there is a rectal fistula a little way up the canal we cut the septum up to the fistula, led me to follow that procedure in dealing with this case although a rather normal looking perineal structure was present, except that it ran a little high, showing that part of the operative work had been done on the labia majora. Carrying the finger fairly well forward in a vaginal examination we would find the cervix and carrying it backward it entered the rectum. There was a fistula in the region of the normal anal opening which would just about allow a probe to be introduced. That tissue furnishing the perineal structure might be looked upon as so valuable that one would hate to sacrifice it. But when we cut that structure down instead of disposing of any valuable perineal structure, we merely had two raw surfaces, one to either side of the vagina. The septum between the vagina and rectum now presented. We split the septum and had just the same condition we would have in a complete laceration of the perineum, only in the latter case we would expect the sphincter to be present although torn through. In this case we had no hope of having a sphincter in that region, it was somewhat doubtful if a sphincter ever existed there. If it ever did the twelve operations would have disposed of the sphincter muscle. If the sphincter muscle is absent we can make something of a sphincter muscle of the levator ani muscle provided it is drawn up close around the rectum. So after splitting the septum the levators were united making them encircle the rectum, after which purse-string sutures were made to draw down the anterior and posterior flaps and the superficial intervening perineal structures were closed. This left a very fair perineal region with the anal opening where the fistula formerly existed. By this method there was no great difficulty in establishing a separate opening for the vagina and rectum, as the vaginal and rectal walls were complete. This alone would be a source of considerable satisfaction to a young woman. If we can add to that better control, so much the better. The patient tells us she is able to control the fæces well, and this is

evidenced by the appearance. She has been working all day and there has been no washing and yet there is no soiling and that has been the case every time I have seen her since she left the hospital. The anal region still shows some scar tissue. Nothing was done to remove the scar tissue. When the perineum was cut down a raw surface was left on each side where several stitches were necessary to close them. As she draws up you can see the action of the levator ani muscle but there is not much sphincter action evidenced. The point in closing this was to get the levator ani muscle to draw this rather close and to make the anal opening small. She can now control solid and semisolid fæces and has just a little trouble with very liquid fæces but she has more trouble in keeping the opening large enough to have good bowel movements. The bowel movements must be kept pretty soft but that is much preferable to having the opening too large. When the finger is inserted about half way the stricture draws pretty tight around the finger. We suspect that she will have to have that dilated once in a while, but she feels that our efforts have been successful and she is enthusiastic about the results.

CASE 2. This patient presents a few points of interest from the standpoint of the obstetrician and gynecologist. I have never found that the study of a case from the standpoint of the specialist was much different from the standpoint of a student and therefore you will pardon this elementary presentation. The interesting thing is that we have a patient with an enlarged abdomen. If we run quickly over the points of diagnosis we find that it is not due to a fatty abdomen, not to ascites, and not to fibroids, and it narrows down to the question of whether it is an ovarian cyst or pregnancy. This patient came in with the diagnosis of ovarian cyst, and was sent up for operation; then when she was examined under the anæsthetic it was thought best not to operate at that time. There was a history of having her menstruation regularly, and that is an interesting point because it sometimes happens during pregnancy but not often. There is a point of interest here in that this patient does not speak English well and the examiner did not speak Hebrew well and whenever we have those conditions we must allow a little for a mistake in the history. The question of her menstruating every month might be a mistake, and upon questioning her further we found she had not menstruated for four months. This size of tumor could not be accounted for by a four months' pregnancy, so possibly she did menstruate for a time or possibly there might be a pregnancy and an ovarian tumor, accounting for this larger size.

We find on manipulation that it starts with the contour not very well marked, symmetrical but not definite, very flabby not definite as the cyst usually is, and on manipulation it changes form and contracts. If we watch it carefully we find that every once in a while there is an impulse. No heart sound could be heard so that was considered an extra reason why it was an ovarian cyst. The fœtus might be dead but palpation shows that it is not dead. She is forty years of age, the breasts are very flabby, and yet flabby as they are we would say there is an extra amount of duskiness. The breasts are rather more knotty than we would expect a flabby breast to be. Further, we are able by examining this patient with a rubber around a stethescope to make out the fœtal heart sounds. If we were unable to make these out we would proceed to the vaginal examination and here, two months ago, she began to have a feeling of enlargement and something presenting at the outlet. It is not the size of the cystocele alone but the soft velvety feel and the dusky color that indicate pregnancy. Large varicose veins present — their color, size and softness are suspicious. In one case reported before this society we thought we had an ovarian cyst separated from the uterus, the cervix was very long and large and enlarged above the vagina more than in the vagina, so we thought we felt the whole uterus separated from this very movable mass. The mass was irregular in outline, not symmetrical, and afterward we found the cause — the patient had twins. She was operated upon for an ovarian cyst and as soon as we got into the abdomen we found it was a pregnant uterus and later she gave birth to twins at full term. Sometimes with a partially developed fœtus the operator can gather the cervix and some part of the fœtus between the hands and the condition will be such as to justify the thought that the uterus is being palpated separate from the mass.

On examination in this case nothing of that kind was found. The cervix extended to the mass and then indefinitely was lost in the soft tumor. Of course it was not necessary to examine further when we heard the fœtal heart sounds, but we took an X-ray which showed the fœtus very plainly.

CASE 3. This patient came in with a diagnosis of ovarian cyst. She is not on my service and I have seen little of her but there are some things that are interesting. She presents a tumor mass. In the first place it is not properly located for an ovarian cyst. There is a large mass which is very tense lying high on the right. The suspicion of malignancy is furnished in that she presents a long operation scar and yet the tumor is still present. An exploratory incision was made. The patient is very much emaciated; the tumor does not seem to connect with the pelvis; there is a rather rigid mass in the pelvis on the right side and yet as we feel above it one mass is one thing and the other something different. There is some blood in the urine; the bladder was cystoscoped and found coated with phosphate. There was marked redness in other areas. The ureters were not catheterized because with the amount of cystitis which was present it was difficult to see them. The cystoscopist thought best not to try to catheterize her until the cystitis

Dr. Lee's Case 2. Marked diastasis recti.

Dr. Lee's Case 3. Marked antiflexion of uterus.

cleared up. This case is thought to be a hypernephroma, and the cystoscopist is also inclined to think of tuberculosis of the kidney.

OVARIAN TUMOR. DIASTASIS RECTI. MARKED ANTIFLEXION OF UTERUS

DR. LEE: CASE 1. A girl 16 years old and unmarried, came to the hospital because operative induction of a some weeks' overdue labor was proposed, and for such an operation her father considered hospital care necessary.

She was duly admitted to the obstetrical ward and a history obtained of irregularity of menstrual flow but with also cessation for a considerable time. The fœtal heart-tones were recorded but the maternal heart rate was synchronous and explained the origin of the error.

My attention was called to her by the interne because he was unble to determine the presentation.

The striking fact immediately recognized was the resistance of this supposedly pregnant uterus. The only pregnant uterus in my experience at all comparable to this ligneous consistency was a case of ablatio placentæ where marked hæmorrhage of the concealed type had ballooned up markedly the uterus, which was not only of increased rigidity but markedly painful as well. Yet this supposed uterus was right for size, shape, and position. The diagnosis was revised, X-ray showed only a uniform shadow through the mass. Careful pelvic examination revealed anterior to this mass and behind the pubis a small mass that was suspected of being the uterus. Operation established the diagnosis of a right ovarian tumor, solid and weighing more than eight pounds after removal. This operation was a source of satisfaction to all concerned — especially as it removed a stigma from the patient's name.

CASE 2. This patient may present some aspects of interest. We see many cases here that have had antecedent treatment, not always wisely in outside hands.

Here we have a case of marked diastasis recti with prolapse of the uterus through the gap. The marked ulceration and excoriation of the abdominal wall due to this is evident. A few months ago a laparotomy was performed and the scar has given away. This shows that operative procedures may

account for the same condition that we find in multiparæ, often to a very marked degree.

CASE 3. About a year ago we had such a multipara negress, with marked antiflexion of the uterus without any operative cause. In a sitting position the uterus was supported by the thighs.

The question of procedure when this patient went into labor arose from the fact that reposition of the uterus to a normal axis was very difficult because of pain and adhesions. A recumbent position was not available because of obesity, with a weak heart.

But in a semirecumbent position with abdominal swathes exerting traction with weights, a gradual elevation of the fundus was secured and the head entered the pelvis, after which the labor was uneventful. In the case just shown we will allow the patient to enter labor and anticipate spontaneous delivery.

PYELITIS COMPLICATING PREGNANCY. SECONDARY ANÆMIA AFTER INCOMPLETE ABORTION. OBSTETRIC TOXÆMIA. ROBERT'S PELVIS.

DR. HENRY F. LEWIS: I will show first two cases of pyelitis complicating pregnancy. Both were observed and studied in consultation with the urologist of the hospital, Dr. Frank M. Phifer.

CASE 1. The patient has been in the hospital for about six weeks. When she entered she had a temperature ranging as high as 102.5° F. and the leucocytosis was very high; there was extreme pain and tenderness in the right lumbar region, extending around to the back and into the right inguinal region. The case resembled one of acute appendicitis in several of its aspects. The pain was so great that morphine was necessary. Our diagnosis lay between pyelitis and appendicitis; therefore operation was delayed.

She was examined cystoscopically on December 2, and the bladder was found perfectly normal. Urine from the right ureter showed a large number of very virulent motile bacilli, resembling colon bacilli. Autogenous vaccines were made. The urine passed *per urethram* also was rich in these bacilli. December 5, she was given 50 million; December 7, 100 million, and December 9, another 100 million dead bacilli. After the first injection, there was a slight chill, fever of 104° F. and slight fluttering around the heart which persisted for about an hour. After the second there was a very severe reaction, shown by marked chill, weak and faint pulse and depression. This persisted for four hours. The reaction after the third intravenous injection of the vaccine was slight. The first two brought about high leucocytosis.

Pelvic lavage with 1 per cent solution of silver nitrate was given three times a week at first and later once a week. She now comes to the hospital each week for this treatment, having been discharged from the hospital about one month ago. She has also taken ten grains of sodium citrate three times a day.

CASE 2. This patient came in December 17, 1916, with the examining room diagnosis of five months' pregnancy and endocarditis. There was considerable dilatation of the heart, temperature of 102° F., pulse of 130 (very weak), and extreme cyanosis. The case appeared to be one of acute endocarditis. She was given digalen hypodermically and afterward digitalis tincture by mouth. She had severe pain in the right side of the abdomen and back, considerable cough, hæmoglobin 40 per cent, reds 2,900,000, whites 6,800, negative blood cultures, albuminuria and a slight dullness at one time in the lower portion of the left chest. On January 2, 1917 the X-ray showed the lungs patent, the heart slightly enlarged. Repeated examinations of sputum were negative for tubercle bacilli.

On January 17, the heart was greatly improved. From the history and examination we judged her to be pregnant about seven months. Cystoscopic examination January 3, showed the vesical mucosa pale, and ureteral orifices not especially congested. On the former date, under gas and oxygen anæsthesia, the conical metreurynter was introduced and labor started. The next morning the labor terminated with the birth of a recently dead fœtus of about thirty weeks. January 31, urine from the right ureter was found to contain a gram-negative bacillus resembling the colon bacillus. Urine from the left side was negative.

This patient is improving under lavage of the right ureter and pelvis with 1 per cent silver nitrate solution.

I will next show two cases of secondary anæmia following incomplete abortion.

CASE 3. This patient came in January 2, with a diagnosis of abortion recently induced. She is 21 years old, complains of vaginal hæmorrhage, weakness, and shortness of breath. December 3, she began to bleed, without having had any pain, and continued to do so nearly constantly until she entered the hospital. She came in because she was getting gradually weaker with the continual bleeding. There were no chills, urinary or bowel disorders. She was short of breath on the slightest exertion.

Examination showed a poorly nourished negro girl with mucous membranes very pale, coated tongue, and enlarged tonsils. Pulsation in the carotids was marked; the apex beat was in the sixth interspace in the midclavicular lines; the lungs were negative; the abdomen was relaxed and not tender; from the external genitals a small amount of thin, watery blood was flowing; the blood pressure was 148, systolic, and 96, diastolic. The uterus was emptied by dull curettage of the secundines. Gauze was packed into the uterus and vagina and removed the next day. Hæmorrhage did not return. Blood examination January 3, showed hæmoglobin 12 per cent, reds 1,552,000, whites 12,000. On January 7, hæmoglobin was 40 per cent, reds 2,360,000,

whites 7,200. Yesterday the hæmoglobin was 45 per cent.

The treatment has consisted of rest in bed, forced feeding with frequent small meals. As soon as the uterus was emptied of the small amount of secundines present the bleeding stopped and has not returned. We have made it a rule here not to empty the uterus in cases of incomplete abortion except for hæmorrhage.

CASE 4. This patient is a woman of twenty-nine whose last menstruation was December 9, and who entered the hospital February 6. Two weeks before entrance she lifted a heavy tub and began to bleed the next day. The hæmorrhage was profuse and continued for eleven days. She lost a great deal of blood and became very weak. She was dizzy when she attempted to stand and for a week has had intense occipital headache.

Examination showed extreme pallor of skin and mucous membranes; the lips were almost white. A number of the teeth were carious; incidentally she has a slight enlargement of the thyroid in the median line. There was a slight mucopurulent discharge from the vagina on entrance; she had not bled for several days. Hæmoglobin was 20 per cent, reds 1,600,000. whites 6,800. She developed acute tonsillitis two days after entrance but the condition cleared up promptly. February 15, hæmoglobin was 25 per cent. She is feeling stronger and is improving in every way.

CASE 5. This is an example of obstetric toxæmia, to use the excellent term recently applied to the toxic disorders of pregnancy, labor, and the puerperium by Dr. W. A. N. Dorland.

The patient came into the ward February 14, in a comatose condition, unaccompanied by friends or relatives and so no history was at that time obtainable. She was apparently pregnant about 30 weeks. Examination showed a well nourished woman apparently about twenty-five years old; eyelids closed, tongue swollen and lacerated, with flakes of dried blood about the mouth. She could not be roused but made movements with all her extremities. Blood pressure was 178 systolic and 120 diastolic. Soon after she entered, about 10 a.m.. she had a convulsion. We afterward learned from her brother that she had suffered from a very severe headache for two weeks and had four spasms earlier in the morning before entrance. She had also complained of inability to see a little while before the convulsive attacks came on.

She was given morphine and chloral and had no more convulsions from the time of entrance until 3 p. m. as she was being taken to the operating room. Shortly afterward I performed the abdominal cæsarean section and delivered a seven months' living baby, which soon cried vigorously and is still in good condition in the incubator. The woman did very well, had no more convulsions, and gradually returned to consciousness. As you see her now you will notice that she has practically regained control of herself and is in fine condition. The tongue is still swollen and tender. She did not pass urine last night for several hours, but just as we were about to pass the catheter she voided fourteen ounces; she has urinated freely ever since. This evening she says she is hungry.

CASE 6. This patient is a negro girl of fourteen, a primipara, pregnant at term. The chief point of interest beyond her youth is her pelvis. The measurements show: interspinous diameter 22 centimeters, intercristal 25 centimeters, bitrochanteric 28 centimeters, external conjugate 19 centimeters, diagonal conjugate 12.5 centimeters. This is a degree of transverse contraction resembling the moderate form of Robert's pelvis. The back of the fœtus lies far to the right and the head lies transversely just above the brim. The head is fairly well developed and the heart tones are heard about over McBurney's point. The danger, of course, is in the position which the head may assume in this Robert's type of pelvis. If the test of labor fails to cause engagement within a few hours it is probable that a cæsarean section will be done. It is always well to remember that these young girls seem to undergo labor, even with the small pelvic diameters which they often show, better than do older primiparæ.

DISCUSSION

DR. CHARLES E. PADDOCK. In regard to the last case, in my experience, which is perhaps somewhat limited, young girls of twelve or fourteen have a comparatively easier labor. I think the children are not quite as large. In a colored woman I am of the opinion that we might expect to find a somewhat smaller head in comparison to the pelvis and a head that can be molded more easily than in more advanced pregnancy. I think the size of the abdomen may be accounted for because of the position of the child, and in that position we would not expect the head to engage at the beginning of labor. The head will be higher up under the ensiform.

DR. W. A. NEWMAN DORLAND: I object to terming the pelvis a Robert pelvis. That is an extremely rare form of congenitally deformed pelvis, characterized by the absence of both alæ of the sacrum. This results in a marked lateral contraction of the pelvis. In this patient I would regard the pelvis either as a slight degree of rachitic deformity or more probably a justo minor pelvis.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

THE publications submitted this month for review surely portray medical art — art in its true sense based on careful, painstaking study, diligence in its production and originality.

It is pleasing to the reader to see comprehensive, exhaustive treatises written by experts, who combine their natural artistic ingenuity with scientific facts obtained from almost endless clinical observations and research work. This combination is pregnant with great things, as one can readily see by glancing over the pages of any of the mentioned works. The fields are varied, and apparently widely separated, but as one proceeds in each the general trend leads in the same direction, and soon one sees the futility in trying to confine a study to any one part of the human anatomy. This is most clearly demonstrated in the excellent treatise by Loeb[1] on *operative surgery of the nose, throat, and ear.* One can say without a moment's hesitation, that the profession has at its hand a masterpiece.

Volume I, dealing chiefly with anatomy, laryngoscopy, and plastic surgery, appeared in 1914. The author and his collaborators must be congratulated on their excellent production. There are many points in this work which deserve mention but the outstanding essentials are the beautiful, original drawings and illustrations, and the arrangement of the text, so that the illustrations referred to are constantly before the reader. One must confess annoyance when reading a book to be constantly referred to a cut appearing three or four pages ahead or behind the page he is reading. This is entirely done away with in Loeb's work. The text is brief yet comprehensive, the type bold and clear and the paper excellent. The book is divided into five chapters: Chapter VII, which is the first chapter of volume II, deals with the operative surgery of the nasal cavities — the accessory cavities and the hypophysis as approached through the nose and accessory sinuses; chapter VIII, the operative surgery of the pharynx and nasopharynx; chapter IX, endolaryngeal operations, chapter X, operations of the external ear through the canal; chapter XI, surgery of the mastoid process. Every phase of nose, throat, and ear surgery is included. The text of the different operations is classified into indications, contra-indications, preparation including anæsthesia, technique of the operation, dressings, after-treatment and complications, and accidents. Following this the different methods of technique are discussed, as for instance, in the operation on the nasal septum, after the author's technique are mentioned the saw operation, removal with chisels, heavy knives and trephine, the operation of Asch, Watson, Gleason, Roberts, Sluder, Kyle, Price, Brown, Moure, and the oral method. Thus we have not only the author's choice, but all the standard operations.

In the chapter on surgery of the mastoid, the author discusses thrombosis of the lateral sinus and jugular bulb and drainage of the cisterna magna, puncture of the corpus callosum, and brain abscess of aural and nasal origin.

This volume contains 476 original illustrations, many of which illustrate points in surgical anatomy and associated surgical technique. One cannot lay the book aside without saying that this is the best text of its kind before the profession today.

J. A. W.

OUR present knowledge of the internal secretions is well summarized in Gley's[2] small volume. After reading this book, to say we know nothing tangible regarding the internal secretions in spite of all the experimental work that has been done would be a gross insult to the respective workers, but one is impressed by the absence of any definite statement of facts. The author calls constant attention to the fact that to prove definitely an internal secretion is an extremely difficult task, although he has reason to believe certain elements exist and that they have an apparent action. One sentence in the chapter on the distinctive characteristics of the internal secretory glands and the principal products of their activities seems to me to answer the question, viz., "The fact that after castration, the epiphyses persist explains nothing, and needs, on the contrary, to be explained itself."

This little volume affords most interesting reading. It is divided into three chapters. Chapter I, "The Concept of Internal Secretions; Its Origin and Development," considers the history more or less of the work that has been done on internal secretions. Chapter II, "Distinctive Characteristics of the Internal Secretory Glands, and the Principal Products of their Activities," is devoted to the study of the broad principles of internal secretions, what constitutes an internal secretion, the histological,

[1] OPERATIVE SURGERY OF THE NOSE, THROAT AND EAR. By Hanau W. Loeb, A. M., M.D., with collaborators. Vol. ii. St. Louis: C. V. Mosby Company, 1917.

[2] THE INTERNAL SECRETIONS. THEIR PHYSIOLOGY AND APPLICATION TO PATHOLOGY. By E. Gley, M.D. Translated from the French and Edited by Maurice Fishberg, M.D. New York: Paul B. Hoeber, 1917.

chemical, and physiological conditions pertaining, also discussing the character of the different internal secretions with their classification. Chapter III, treats the normal activities of the glands with their respective reciprocal action, also their diseased function. J. A. W.

AS the science of medicine advances in its various branches, efforts are constantly being made to introduce new methods. This applies especially to diagnosis. But a few years ago, the roentgen ray was used almost exclusively in bone work or for the localization of foreign or opaque bodies. Soon the field broadened to include the chest, the gastro-intestinal canal, and the urinary tract. Now, in the hands of the experienced and careful operators, it affords a most useful and necessary adjuvant to the diagnosis of gastro-intestinal disease. The book by Carman and Miller[1] is indeed opportune.

The authors, from their vast experience with a large amount of clinical material, have elaborated a system of gastro-intestinal examination, which to say the least is most comforting to the surgeon and the internist. The information gained by reading this volume is useful not only to the roengten-ray operator, but to the surgeon, the internist, and the general practitioner.

The authors take pains to tell you of the apparatus, the technique of plating and screening, and the opaque mixtures, which in their experience have given the best results. They then take up the anatomic structures, beginning with the œsophagus, giving the individual technique of examination, and the normal organ with its variations, and the pathological changes which can be demonstrated with the roentgen rays.

The chapters devoted to the stomach deserve exceptional consideration. The normal stomach is discussed from the point of habitus, tonus, form, tone, position, size, contour, mobility, flexibility, the gas bubble, secretion, peristalsis, and motility. The abnormal stomach is next considered, giving the variations, in the same manner. Every condition is illustrated by photo-plates which are very clear and instructive. A chapter is given to gastrospasm, drawing attention to its importance in the diagnosis of chronic appendicitis, gall-bladder disease and allied conditions. Two chapters are assigned to gastric ulcer and carcinoma, and the detail is most interesting and instructive. In this as well as in practically all of the abnormal conditions encountered, there are added case histories, with illustrations of roentgen findings and operative diagnoses.

The chapter on duodenal ulcer, although comparatively brief, is most instructive. They give as the roentgen signs in duodenal ulcer: direct signs including deformity of the duodenal contour; indirect signs including alteration of gastric tone, alteration of gastric peristalsis, alteration of gastric motility, gastrospasm, tenderness localized to the duodenum. Each is discussed and illustrated in detail.

Cancer and tuberculosis of the colon as well as diverticulitis, colitis, chronic appendicitis and miscellaneous lesions of the colon, gall-bladder, and liver are presented in a most fascinating way. There is an extensive discussion on constipation and intestinal stasis as presented by Lane, Jackson, and others, and the information that can be gained by roentgen-ray examination.

The authors quote freely from such authorities as Holzknecht, Haudek, Case, Hertz, Jordan, Schwarz, Kaestle, Barclay, Cole, and many others.

Those familiar with, and who are ardent supporters of the roentgen examination of the alimentary canal may gain a great fund of knowledge from this work, and those who look with doubt upon the subject may be relieved of a certain amount, if not all, of their suspicion and mistrust. J. A. W.

WHEN at the outset of our medical course we attempted to unravel the mysteries of the brachial plexus, and to acquire a permanent impression of its source and destination, two names seemed to find an abiding place in our memory — Wrisberg and Bell. "Median" and "musculospiral' might be forgotten, but Wrisberg and Bell remained with us. *They had lived* once, and studied anatomy; perhaps they had been confused as well. In the future they are to live only in encyclopedias and memoirs, and we can only deplore their passing while we recognize the necessity of the change.

Dr. Eycleshymer asks in his preface to *Anatomical Names*,[2] "Since the *BNA* has become the language of the anatomists, may they not hope for the co-operation of the clinicians in clearing the field of thousands of useless synonyms? At the present day it is scarcely possible to find a students' textbook on any clinical subject which evinces the slightest concern as to the uniformity of its anatomic terms." His book offers a real stimulus and aid to the task.

To the student in medicine (not alone the undergraduate), and especially to the man who takes an active part in the teaching of medicine "Anatomical Names" will prove not only of help, but of real interest. The preface recounts briefly the development of anatomical nomenclature, of the tendencies which helped to make it hopelessly ambiguous and confusing, the individual efforts at correcting that tendency, and finally the work of the Anatomical Society which culminated in the formation of the Basle nomenclature.

The translation of His' original report to the Anatomical Society reads like a historian's tale. Throughout one is constantly impressed by the widely divergent opinions which met Krause and his associates at every turn; and by the painstaking care which

[1] THE ROENTGEN DIAGNOSIS OF DISEASES OF THE ALIMENTARY CANAL. By Russell D. Carman, M.D., and Albert Miller, M.D. Philadelphia and London: W. B. Saunders Company, 1917.

[2] ANATOMICAL NAMES. ESPECIALLY THE BASLE NOMINA ANATOMICA. By Albert Chauncey Eycleshymer, B.S., Ph.D., M.D., assisted by Daniel Martin Shoemaker, B.S., M.D., with Biographical Sketches by Roy Lee Moodie, A.B., Ph.D. Wm. Wood and Company, New York: 1917.

they expended on the smallest details of their task. The report includes the entire list of names suggested by the committee, with numerous explanations and notes accounting the reasons for the final choice in those cases in which a number of alternatives suggested themselves. The section devoted to neurology amounts to a comprehensive summary of the anatomy of the brain and spinal cord.

The second portion of the book is devoted to brief biographical sketches of the men who have made anatomy; sketches that make one realize anew that anatomy is not merely an inert mass of knowledge, but the expression and achievement of living men who wondered and worked and discovered.

The largest portion of the book consists of a complete index of anatomical names, new and old, including proper names, with cross references indicating their equivalents in the Basle nomenclature. The names adopted by the Basle convention are distinguished by heavier type, so that the student can rapidly find the meaning of any name, as well as the Basle equivalent for the older synonyms.

Dr. Eycleshymer's book should prove not only of help in the general adoption of the universal nomenclature, but a real stimulus to the human interest in the science of anatomy. S. L. K.

AS medical science advances, specialization furnishes an increasing opportunity for thorough and exhaustive work in any particular field. Medical literature naturally follows the same trend. Subjects such as diseases of the breast, infections of the hand, and fractures, furnish an opportunity for monographs that approach completeness in a single volume. The subject of traumatic surgery on the other hand, possesses an inherent weakness in the real difficulty it presents of determining what part the traumatic factor plays in the etiology of many surgical conditions.

Dislocations and fractures obviously are traumatic; and this section of Dr. Moorhead's book[1] is the best feature of the volume. The pathology of different fractures is well shown, and the entire section is finely illustrated with roentgenograms and photographs.

Are infections traumatic? Infections of the hand are considered so, and discussed at some length. Periostitis and osteomyelitis on the other hand, are disposed of in six pages. Arthritis is considered in four pages, but twelve pages are used in showing Dr. Murphy's treatment of its sequel, ankylosis, and ten more in roentgenograms of the blood supply about the joints.

Is hernia traumatic? The author discusses the question at some length from the medicolegal standpoint, and concludes that trauma is the rarest of all causes. Appendicitis, uterine displacements, abortions all come in for a share of comment in such a way as to leave the annoying impression that the subject had been deemed unworthy of serious consideration, and thrown aside untouched. Discussion of the traumatic neuroses, eye and ear standards, and medicolegal phases help to deepen the feeling that in attempting to cover so diversified a field much of the possible value of the book had been dissipated. S. L. K.

AS students in medical school, we curiously examined specimens of gunshot wounds in the pathological museum as relics of bygone ages, and little dreamed that in our own time the whole subject would be given a new and terrific impulse by the great war.

Colonel LaGarde's revision of his book[2] on military surgery has afforded him the opportunity of including in it some of the recent advances in military surgery. Most important obviously are the methods of dealing with infected wounds, by irrigation with hypochlorous acid solution, with hypertonic salt solution, and by primary excision and suture. The omnipresence of infection in wounds of every sort is emphasized by the high percentage of infections following effusions of blood into the pleural cavity, more than one-third (48 of 120) in one series of cases reported by Bradford and Elliott, and almost one-half (69 of 160) in a second series.

Two chapters devoted to technical considerations are followed by chapters on the symptoms, pathology, and treatment of gunshot wounds in general; and these by successive chapters on wounds of the head, spine, chest, abdomen, peripheral nerves, joints, and bones. A rather technical description of the X-ray as used in the United States army forms the concluding chapter. No mention, however, is made of the newer devices in roentgenography in use by the armies in Europe. The whole volume is splendidly illustrated with roentgenograms and photographs, and should prove a valuable addition to the subject of military surgery. S. L. K.

[1] TRAUMATIC SURGERY. By John J. Moorhead, B.S., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1917.

[2] GUNSHOT INJURIES; HOW THEY ARE INFLICTED; THEIR COMPLICATIONS AND TREATMENT. 2d ed. By Colonel Louis A. LaGarde. New York: William Wood & Co., 1916.

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